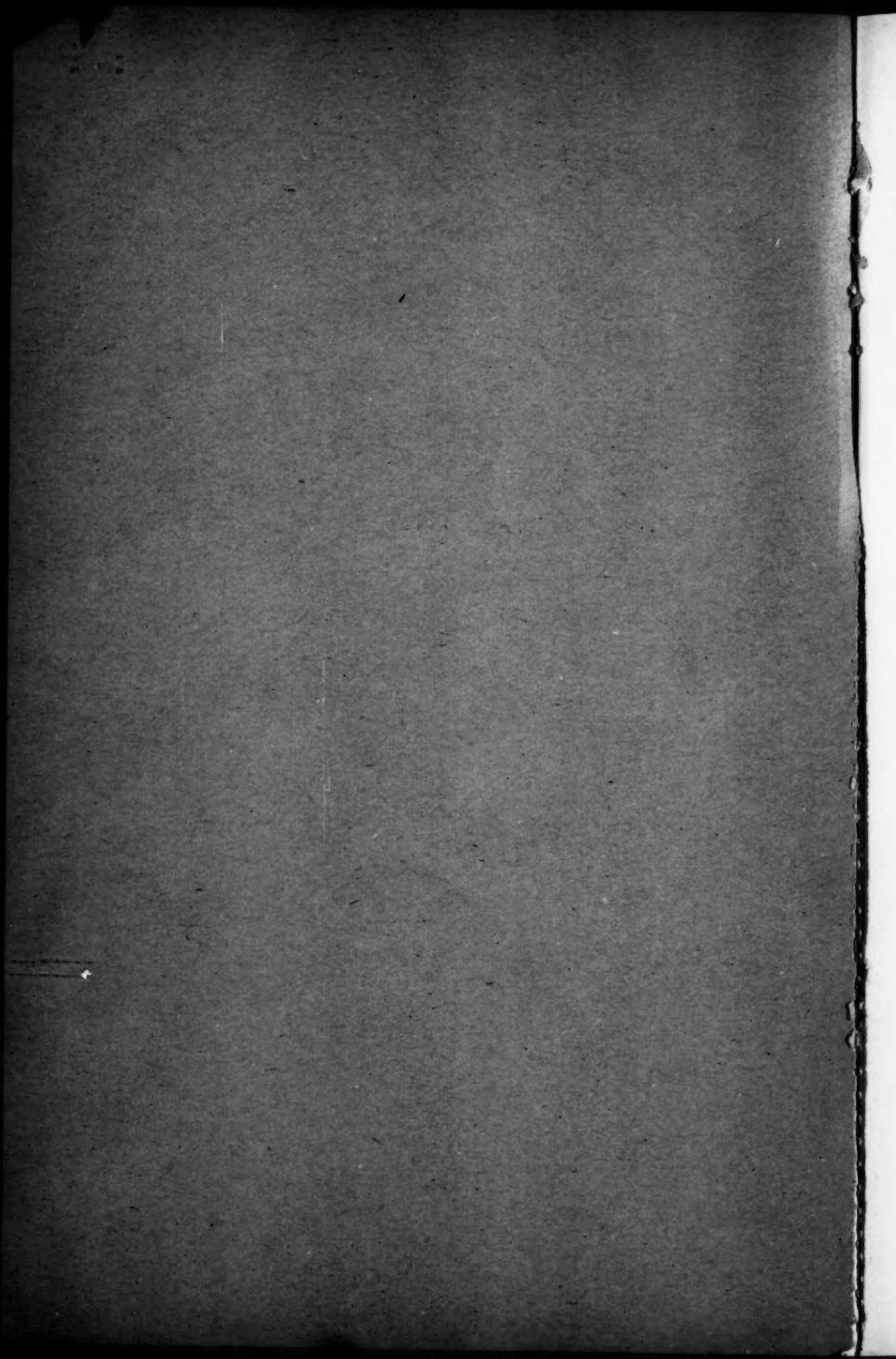




**American
Fisheries Society.**

1894.





TRANSACTIONS

OF THE

AMERICAN

FISHERIES SOCIETY.

TWENTY-THIRD ANNUAL MEETING.

HELD IN

PHILADELPHIA,

Wednesday, May 16th and Thursday, May 17th, 1894.

NEW YORK :

THOS. HUMPHREY, Printer, 359 Canal St.

1894.

Officers for 1894-'95.

PRESIDENT, W. L. MAY..... *Nebraska.*
VICE-PRESIDENT, R. O. SWEENEY..... *Minnesota.*
TREASURER, FRANK J. AMSDEN..... *New York.*
RECORDING SECRETARY, EDWARD P. DOYLE... *New York.*
COR. SECRETARY, DR. JAMES A. HENSHALL..... *Ohio.*

Executive Committee.

H. H. CARY,..... *Georgia.*
L. D. HUNTINGTON,..... *New York.*
HENRY C. FORD..... *Pennsylvania.*
CALVERT SPENSLEY..... *Wisconsin.*
CHARLES L. CHAMBERLAYNE,..... *Massachusetts.*
HOYT POST,..... *Michigan.*

MINUTES
—OF THE—
TWENTY-THIRD ANNUAL MEETING
—OF THE—
AMERICAN FISHERIES SOCIETY,
HELD IN
PHILADELPHIA,

WEDNESDAY, MAY 16TH AND THURSDAY, MAY 17TH, 1894.

The meeting was called to order at ten o'clock A. M. by the President, Henry C. Ford of Pennsylvania. The following members were present :

A. M. Spangler, H. C. Ford, Wm. E. Meehan, B. W. James, W. L. May, Wm. H. Bowman, Robert Hamilton, Fred. Mather, C. F. Chamberlayne, Herschel Whitaker, John Gay, L. D. Huntington, Edward P. Doyle, Howard A. Chase, H. H. Cary, M. D., F. W. Ebel, J. W. Collins, Marshal McDonald, F. H. Bean, Richard Rathburn, M. D. Cornwall, William L. Taylor, M. D., W. S. Andrews, J. S. Van Cleaf, H. Van Cleaf, H. A. Wilbur, F. Ellis, B. L. Douredoure, A. H. Miller, W. L. Powell.

On motion, the calling of the roll was postponed

until the afternoon. A telegram was received from R. O. Sweeny, Treasurer of the Society, announcing that it would be impossible for him to be present at the meeting and sending a statement of his account.

On motion, John Gay of Pennsylvania was appointed Treasurer pro tem.

The minutes of the last meeting having been printed in the report as published, on motion, the reading of the minutes was dispensed with.

The President appointed the following committee on nominations of officers for the ensuing year; W. L. May of Nebraska, Herschel Whitaker of Michigan, H. H. Cary of Georgia, John Gay of Pennsylvania and William H. Bowman of New York.

Dr. B. W. James of Pennsylvania, H. H. Cary of Georgia and W. L. May of Nebraska, were appointed a committee to audit the accounts of the Treasurer.

On motion, a Committee of three was appointed to determine the time and place of the next meeting. The President appointed as such Committee W. L. May of Nebraska, L. D. Huntington of New York and B. W. James of Pennsylvania.

On motion, the following gentlemen being duly nominated and seconded, were unanimously elected members of the Society :

Howard A. Chase of Philadelphia, William E. Meehan of Philadelphia and William T. Wardle of New York.

The President, Mr. Ford, then addressed the Society at length upon its work.

A paper was read by Fred. Mather on "Improved Methods of Hatching Smelt."

A paper was read by Dr. B. W. James on "Alaskan and Behring Sea Fishing Interests."

A paper was read by Charles Hallock, entitled "When Shad were a penny a piece."

Mr. Doyle offered the following resolution :

RESOLVED. That the President appoint a Committee of three on Increase of Membership, such Committee to have full power to solicit eligible persons to join the Society ; subject, however, to the right of the Society to reject or elect such persons to membership.

The motion was pending when the motion to adjourn was made and carried, and the convention adjourned to meet at two o'clock in the afternoon.

MINUTES OF ADJOURNED MEETING HELD WEDNESDAY, AT
TWO O'CLOCK IN THE AFTERNOON.

The pending question, being the resolution providing for a Committee of three on Increase of Membership, was put and carried. The President appointed as such Committee, Edward P. Doyle of New York, Herschel Whitaker of Detroit, Michigan, and W. L. Powell of Harrisburg, Pennsylvania.

A paper was read by Herschel Whitaker on "The Artificial Propagation of Black Bass."

A paper was read by Tarlton H. Bean on "The White Fish."

A paper was read by Col. Marshal McDonald, United States Fish Commissioner on "The Relation of the Fisheries to the Community."

Col. Marshal McDonald invited the members of the Society to a trip down the river on the United States

Fish Commission Steamer "Fish-Hawk," and placed the steamer at the disposal of the Society.

The President, in the name of the Society, thanked Mr. McDonald cordially for his invitation and accepted it.

A paper was read by Livingstone Stone on the "Non-Feeding Habits of Chinook Salmon."

A paper was read on "Handling of Adhesive Eggs," by J. J. Stranahan.

On motion, meeting adjourned to meet Thursday, May 17th, at ten o'clock.

MEETING WAS CALLED TO ORDER PROMPTLY AT TEN
O'CLOCK.

A resolution was passed, thanking the Pennsylvania Fish Commission and the Protective Association of Philadelphia for their kindness in providing an entertainment for the delegates.

On motion, the Secretary was directed to enter upon the minutes of the meeting an expression of the Society's thanks to Col. Marshal McDonald for his kindness in putting the steamer Fish-Hawk at the disposal of the Society.

The following resolution was offered by Secretary Doyle, and unanimously adopted :

WHEREAS, the proceedings of this meeting have been fully and accurately reported in the press of this city, therefore be it

RESOLVED, that the thanks of the Society be tendered to the newspapers of the City of Philadelphia for their kind appreciation of the importance to the

people generally of the interest the Society represents and the consideration the press has given to the reports of its proceedings.

The Secretary offered the following resolution, which, upon motion, was unanimously adopted.

RESOLVED, that the Committee on Increase of Membership be requested to invite all Fish Protective Associations of the United States to join the American Fisheries Society, on payment of Three Dollars each for annual dues, such membership to entitle the said associations to representation by one delegate at the annual meetings of the Society.

The Committee on Nominations presented the following report :

TO THE MEMBERS OF THE AMERICAN FISHERIES SOCIETY:

Gentlemen :—Your Committee on Nominations, to whom was referred the matter of reporting candidates for the various officers of the Society, have met and considered the matter referred to them, four members of the Committee being present, Mr. May not sitting, and have directed me to make the following report.

For President, W. L. May of Nebraska; for Vice-President, R. O. Sweeny of Minnesota; for Treasurer, Frank J. Amsden of New York; for Recording Secretary, Edward P. Doyle of New York; for Corresponding Secretary, Dr. James A. Henshall of Ohio.

Executive Committee, H. H. Cary of Georgia, L. D. Huntington of New York, Henry C. Ford of Pennsylvania, Calvert Spensley of Wisconsin, Charles

L. Chamberlayne of Massachusetts, and Hoyt Post of Michigan, all of which is respectfully submitted.

On motion, the report was received and unanimously adopted, and the officers declared elected for the ensuing year.

The Committee on Place and Time of Next Meeting reported in favor of meeting in the city of New York, on the second Wednesday of June, 1895.

On motion, report was adopted.

On motion, the following resolution was adopted :

RESOLVED, that the Secretary of the Society be directed to enter upon the minutes of the meeting an expression of the thanks of the delegates present to the members of the Pennsylvania Fish Commission and Pennsylvania Fish Protective Association for the generous entertainment provided to the members of the Society attending this meeting.

REPORT OF RECORDING SECRETARY.

GENTLEMEN :

The writer of this, although elected Recording Secretary at the meeting held in Chicago, in 1893, never accepted the office, and the question of determining his successor was referred, with power, to the Executive Committee although no action was taken by that body. This statement is made partly as an apology for what may have seemed to the members careless and negligent management of his office by the Recording Secretary. Publication and delivery of the report was delayed and a number of matters of importance given insufficient attention. As a partial result of this inattention to business the membership of the Society has not increased, the total active membership remaining at about 200, and with an active Recording Secretary the membership of this Society could be easily increased to 2,000 or 3,000 persons, and the sphere of its influence and importance enormously extended. The result of some work done in 1892 convinces me of this. At that time I succeeded in inducing every Fish Commissioner of the United States to join this Society, and I am satisfied that by faithful work every Fish Protective Association of the United States would have at least one representative in our Association. This would give us an influential and extensive membership, powerful and good for securing desired protective legislation and in educating public sentiment so that such legislation might be thoroughly enforced. The annual meetings of such a Society, with delegates representing well organized local Societies throughout the United States, would attract great attention and the result of its deliberations be of the utmost weight. In view of the growing interest of the people in matters relative to fish

cultivation and protection and the increasing public appreciation of the economic value of the work of the State and National Commissions, it seems to me that an attempt should be made to have this Society made the mouth-piece and representative of this aroused public sentiment. The people then speaking through an organized body could express more clearly what was needed to protect the fish and game, and such an expression would have more weight than coming from an individual or local association. If the American Fisheries Society could be made a strong central organization, as I have suggested, we would have an association whose influence upon all questions affecting this most important subject (the maintenance of one of the great sources of the food supply of the people) would be all powerful. The suggestions of such an organization would never be slighted and its recommendations would be welcomed and adopted. I have prepared and will submit for the consideration of the Society a resolution providing for a committee of three who shall be charged with securing an increased membership for this Society. This committee to have power to send out circulars and to form other committees, and to do everything it may deem necessary to secure members subject, of course, to the right of the Society to accept or reject any applicant for membership.

Very respectfully,

EDWARD P. DOYLE.

TREASURER'S REPORT.

R. O. SWEENEY, Sr.

IN ACCOUNT WITH

AMERICAN FISHERIES SOCIETY

1893.	DR.	
July 20.	To check from H.C. Ford	\$126.86
Dec. 28.	To membership dues paid in to date.....	159.00
1894.		
May 14.	Membership dues collect- ed up to date.....	138.00
		<hr/> \$423.86
1893.	CR.	
July 31.	Postage Stamps.....	\$ 3.00
Aug. 7.	H. C. Lemaér Bros., N. Y., Circulars, Etc.	16.65
Aug. 21.	Stamps.....	1.00
Sept. 13.	"	1.00
" "	Collection on checks.....	.20
" "	J. J. Le Tourneau, print- ing bills and envelopes..	4.00
Oct. 3.	H. Whitaker, Stenography Chicago meeting.....	20.00
Nov. 2.	Stamps.....	1.00
" 16.	Express charge on Pam- phlets.....	1.15
" 17.	Jno. M. Davis, printing reports.....	278.50
	Express charge.....	25 278.75

1894.		
April 17	Stamps.....	3.00
	May Flint, N. Y., Steno- graphy.....	14.62
" 20.	Stamps.....	1.00
" "	J. J. Le Tourneau, Print- ing	1.00
" "	J. L. Coffey, N.Y., prepar- ing report.....	10.00
	Cash on hand.....	67.49

		\$423.86

R. O. SWEENEY, Sr., Treasurer.

DULUTH, MINN.,
MAY 14TH, 1894.

Examined and found correct, May 29th, 1894.

H. H. CARY, *Auditing Committee.*

ADDRESS OF THE PRESIDENT.

GENTLEMEN OF THE AMERICAN FISHERIES SOCIETY:

When your society met in these rooms in 1889, the organization that then extended to you its welcome was designated "The Anglers' Association of Eastern Pennsylvania." A broader view, however, of the work confronting them in their State, prompted a change of name to "The Pennsylvania Fish Protective Association." Under this title the work commenced by its members as anglers for the perpetuation and increase of fish in Pennsylvania for purposes of sport has been raised to the higher and nobler plans of propogating and protecting the supply of food and game fish for the benefit of the people. And for this end it has sedulously labored and steadily impressed upon Fish Commissioners and legislatures the fulfillment of its motto "The enforcement of the laws and the protection of the spawning fish." This statement, however, implies nought that is derogatory to the angling fraternity, for from the anglers came the first fish culturists. Seth Green and Thaddeus Norris learned first to cast the fly before they delved into the mysteries of hatching boxes.

And even at this late day, our anglers, men of close observation, whose calling renders them familiar with the habits of fish, can often correct errors that ichthyologists and fish culturists sometimes erroneously promulgate. As an instance, a fish cultural article relative to shad appeared a few years ago stating that shad always spawned between nine and twelve at night. A thoughtful man might well have wondered how any fish culturist could discern spawning shad in these dark hours, but it was reserved to an observant angler on the Upper Delaware to utterly disprove this theory and show that shad spawned in broad daylight.

In drifting over the quiet eddies of the river, he had looked down into the clear waters and there above the gravel bars had seen the exudation and impregnation of spawn, a sight than can be witnessed any day during the shad season on the Upper Delaware.

The continuous testimony of anglers against the introduction of foreign fish into our waters, and especially into our trout streams, is also bearing its fruit in the recommendation of our State Commissioners to plant no foreign trout in the native trout streams, for if the anglers are to be trusted, and there is no reason to doubt their opinion, our native brook trout are far superior in edible and gamey qualities to the foreign importations, and therefore as the best fish they are *best* for the streams.

Our angling friends say also that the European Carp is fast becoming a nuisance in many of our waters, and though coming with the reputation of a vegetarian, labors under the imputation of devouring the spawn and sometimes the young of better fish.

On this, the twenty-third annual meeting of your Society, it might be well to take a brief retrospect of the past.

When this society was formed in 1870, fish cultural operations were in their infancy. The Michigan Commission that now pours its millions of white fish and pike perch fry into the surrounding great lakes, was not created until 1871, a year later. The New York Commission was in a similarly inchoate state. The Pennsylvania Commission was just beginning to have its conception in the brains of a few enthusiastic anglers, so that the first meeting of the Society was composed not mostly of Fish Commissioners, as at the present, but of the Fish Culturists, and by them was named the American Fish Culturists Association. In 1878 this title was changed to that of the American Fish Cultural Association, and in 1884 to the American Fisheries Society, which name it has since retained.

Probably there is no better way of measuring the progressive strides of fish culture in the United States than to take the single instance of a State like Pennsylvania.

Twenty-three years ago there was no trout hatchery in the State. The Fish Commission had just been created. About two thousand black bass were distributed in the larger Eastern rivers and streams, and with the aid of Seth Green a few hatching boxes for shad were at work in the Susquehanna and Delaware. But little restrictive legislation had been enacted, and even these protective laws were not enforced, for the people generally looked on the fishery laws as so many restrictions on personal liberty, and they were held in supreme disfavor.

Every stream in the State, from the Delaware and Susquehanna rivers down to the mountain trout streams, was filled with the deadly fish weirs that were rapidly depleting the waters of their supply of fish food ; and there was no restocking to restore the constant decrease of fish. People did not then pause to reflect that even as their land would be exhausted if the nutritive elements of the soil were not constantly renewed so the fruitfulness of the waters would become barren if their fish supply was not kept up. This was the condition of Pennsylvania waters in the early seventies, and for some years later ; for reform, especially when tardy and experimental, requires time for its successful development.

It would be interesting, but too lengthy, to note the different processes of the gradual change that has restored to Pennsylvania her great shad fisheries of the Delaware, that has made the City of Erie one of the largest fish marts on the great lakes, and that has renewed her thousands of trout streams, for many of you may not be aware that Pennsylvania next to Maine has more trout streams, and more trout producing area, than any State in the Union.

It would be interesting to note the steady enactment

of restrictive laws, not without opposition, and to mark the contest of progress with ignorance and lawlessness, until to-day the fishery laws are respected where they were once set at nought.

Within the last three months, from our hatcheries thirty millions of white fish have gone into Lake Erie, eighty millions of wall-eyed pike have been deposited in the same lake, and in our larger rivers and streams. Over four million of the different varieties of trout have been placed in our streams. Five million of blue pike are hatching in the Erie Hatchery for the benefit of that lake, or a total of one hundred and nineteen millions of fish planted to replenish the food supply of the people, to say nothing of the millions of shad fry that during the season will be deposited by the United States Commission in the Delaware and Susquehanna, by our own hatching on the Upper Delaware.

Do not think, gentlemen of the American Fisheries Society, that these weighty statistics are mentioned boastfully, as showing what Pennsylvania has done, and leaving the inference that no other state has done as well. The history of Pennsylvania fish culture is likewise the history of Michigan, New York and Wisconsin fish culture. It is the history of the American Fisheries Society, for the men who are the members of this Society have made such statistics possible and practicable.

Yet, gentlemen, it would seem that this Society should have a greater work marked out for it than to merely meet once a year for the purpose of collating experiences and papers. Its influence should be felt where legislation beneficial to fish cultural interests is opposed by adverse influences. It should be a force in the condemnation of erroneous views; and should not hesitate to make itself heard where the expression of its opinion would be a potent factor in the determination of a correct course in fishery matters. With just and impartial decisions, and uncontrolled by faction, the American

Fisheries Society has before it a future, which if properly developed, will make it a power in fishery matters even greater than it has been in the past.

The Society is National in its membership and in its work, and fishery issues that are National should not be foreign to it. Its vigilance should extend not only over our inland lakes, our interior streams and rivers, but also to the broad Pacific and the nearer Atlantic, to correct abuses that clearly come within its province for vigorous condemnation.

HENRY C. FORD, President,
AMERICAN FISHERIES SOCIETY.

PAPERS READ BEFORE THE
American Fisheries Society,
WITH THEIR DISCUSSIONS.

WHEN SHAD WERE A PENNY A-PIECE.

BY CHARLES HALLOCK.

Every schoolboy knows in a general way that shad were once so abundant in the Connecticut river that hired men used to stipulate that they should be served with only a limited quantity per week for food, but I dare say few people, adolescent or adult, are aware that it was considered disreputable a century and a half ago to eat shad, and that the epithet of "shad-eater" was regarded as most obnoxious and opprobrious in New England.

Whether it was because shad were in common use by the vagabond Indians who occupied the valley, or because their very cheapness and abundance made them vulgar, history does not state. But it is of record that shad were overlooked, thrown out, and despised as food by a large proportion of the English occupants of the old towns for a period of one hundred years after their settlement. Only poor people ate shad in those days. Shad eating implied a deficiency of pork, and to be destitute of pork indicated poverty. Even now an apology is sometimes made when a family has no "meat,"

as pork was always designated. The story is told of a well-to-do family in Hadley, which was always an aristocratic town, who, hearing a knock at the door just as they were about to dine on this tabooed fish, incontinently hid the platter under the bed. Indeed, so ground into popular sensibility was this ancient prejudice, that as recently as forty years ago members of the Connecticut Legislature were sometimes taunted with the epithet of "shad eaters." The radical change of appreciation which has taken place since can be realized when we find these same people boasting now of the superlative quality of their shad as compared with all others in the market.

Not until forty years before the Revolution was this economic ban removed and shad became a merchantable commodity. Connecticut shad in barrels were first advertised in Boston in 1736, though they were current in river towns for at least three years previous at one penny a-piece. By 1773 prices had advanced to two or three pence, and in 1778 several thousand barrels were put up for the Continental troops. In 1779 the price reached four pence ha'penny, and after the dam was placed at South Hadley Falls in 1795 the number of shad in the river perceptibly diminished and the price gradually advanced to six pence, nine pence, one shilling, and then higher, until men ceased to buy shad to barrel for family use. Thenceforward they became a fancy fish and a luxury, even replacing the salmon, which had always maintained a high precedence, but had now also disappeared by reason of the dams which obstructed their ascent of the river.

Shad never passed the Bellows Falls, at Walpole, New Hampshire, nor the falls of the Chicopee river, in Massachusetts, though salmon surmounted both.

In 1739, according to Sylvester Judd, the historian, the town of Brookfield petitioned the General Court for leave to make a fishway for shad through the ledges of rocks across the Chicopee at Springfield, so that they might come up the river into the ponds, but Springfield

opposed, and permission was not granted. The burglers feel differently now. Until the erection of the dam at Holyoke in 1849 caused an effectual blockade, shad were fairly abundant in the lower reaches of the Connecticut and falls ; wherever they occurred were always chosen fishing places for both salmon and shad. Gangs of professional fishermen hired valuable seining privileges, and during the fishing season in April, May and early June, rival camps were often the scenes of much horse play and frolic at off hours. History tells how the farmers and netters used to gather from all parts of the adjacent valley, and even from Berkshire, to the number of 1,500 or more at a time, just as they gather now on the tributaries of the Columbia when salmon are running, or on the rivers of Nova Scotia for alewives and gaspereaux.

Since the construction of the Holyoke dam many efforts have been made to restock the Connecticut with salmon and shad, and with partial success as respects the latter. But it is very doubtful if its old prestige ever returns, and certain that shad will never again be sold for a penny a piece.

AFTER THE READING OF THIS PAPER,

Mr. Ford said : "The lower part of the Delaware is so taken up with nets that the fish have very little chance to reach the spawning beds. In the upper part of the Delaware River the fish weirs cause a great deal of anxiety but we have at last secured legislation which has eradicated them. We have tried to secure reciprocal legislation between New York and New Jersey so that we can make it illegal to take shad on Saturday till twelve o'clock on Sunday, thus giving the shad one day to get up the river, but naturally we have been unsuccessful. There should be some means devised by which the shad could reach the spawning grounds in the upper part of the river. Now, gentlemen, the construction of

dams in the Delaware, River at Lackawaxen, has helped us very much, althought this is one hundred and forty miles above Philadelphia."

Dr. Cary, of Georgia, asked if there were several well authenticated instances where shad have passed up the fishways. He says, that it is known that other fish do, but as the shad is a very nervous and easily frightened fish, I do not believe that there are many instances where they have been known to pass up the fishway.

Mr. Ford said, "They have passed into New York in very large numbers and through the fishway in Lackawaxen Dam. If you will look into the '91 Report of the New York Fish Commission, you will find that one of the game and fish protectors states that he saw them in such large quantities that they completely covered the bottom of the river and were taken in large numbers."

Colonel Cary said that in Georgia the city of Augusta built a dam across the Savannah River. The people of South Carolina living above the dam protested against the building of the dam, and as a compromise six McDonald fishways were directed to be built in the dam. He had heard nothing from South Carolina since, but the people on the Georgia side above the dam complained that the fishways were inoperative. He himself had visited every fishway in the northern and eastern states, but had never learned satisfactorily that shad had ascended them. There was no doubt in his mind as to their value to other fish, especially salmon, but he doubted whether fish as nervous and timid as shad are known to be, would ascend a fishway. He would like some authority to answer on the question, as the matter was being again agitated on the Georgia side of the Savannah River.

THE HANDLING OF ADHESIVE EGGS.

J. J. STRANAHAN, OF OHIO.

My excuse for preparing a paper on the handling of adhesive eggs must be the general interest taken among fish culturists in the subject, and the difficulty formerly experienced in this field. I however, have a purpose, slightly ulterior in its bearing, and that is to correct a statement made by Professor Jacob Reighard of Michigan, at the last meeting of the Association, as to my plan of handling the eggs of the pike perch. In his paper the Professor stated in substance that my mode of handling adhesive eggs is to permit them to form into a mass and then separate them by rubbing through a screen. Of course it will go without the saying that the Professor has been misinformed. Our plan is—or rather was—to work the eggs continually until the adhesive tendency has passed away, changing the water from time to time, placing them in fifteen gallon wooden tubs—the same used in collecting—on their arrival at the station, where for about twenty-four hours they are left in running water, the watchman stirring them from time to time, or at least once each half-hour.

At the end of the above named time the eggs are fully hardened and not liable to injury. They are then put through a wire screen admitting the passage of but one egg at a time through its meshes, the lumps remaining being rubbed through the screen with a large paint brush with long bristles.

Careful experiments have demonstrated that the eggs are not injured by this course, while if the lumps are permitted to go into the jars the eggs composing them are invariably lost through being carried over by the

formation of air or gas bubbles within the egg mass or through fungusing.

This process, although fairly successful, is very tedious, consuming much valuable time, when the spawn taker is most busy. Many experiments have therefore been made to prevent adhesion among the eggs by both chemical and mechanical means, among the pioneers in this field being Professor Reighard.

Following his directions this spring, I placed in the hands of Mr. John Dukes, one of our most experienced spawn takers, one quart of dry corn starch dissolved in five gallons of water and directed him to place therein, after impregnation and three minutes interval, one gallon of the eggs of the pike perch.

Believing that the Professor's plan might be improved upon, in another keg I placed finely dissolved swamp muck in a solution of about the consistency of porridge, two quarts of this to ten gallons of water, with instructions that the spawn taker place in this such quantity of eggs as the keg would reasonably hold, three gallons being our rule. Mr. Dukes followed instructions, as far as practicable, and brought in one gallon of eggs in starch and two gallons in muck. He reported that if the starch was left ten or fifteen minutes without stirring it settled into a hard cake on the top of the egg mass, incorporating the upper layers, and that it was more work to keep the eggs free with the starch than under our former plan of constant stirring until the adhesive tendency disappears, as in the one case the eggs need attention only while being freed, while in the other they must be almost constantly stirred until the station is reached.

He reported that the muck entirely prevented adhesion and gave no trouble whatever.

After arriving at the station both lots were examined and then placed under running water as usual. The motion of the current carried over nearly all of the starch and a considerable portion of the muck. The next day,

about twenty-four hours after being taken, these two lots were separately removed from the kegs, passed through a screen with meshes just large enough to easily admit of the passage of a single egg, the same as all our eggs are treated, when it was found that there were practically no lumps in either case. In the muck lot there was one lump of five eggs and two of three each, while in the starch lot there was still less, two or three of three eggs each. They were then both put into a screen box with mesh fine enough to just hold the eggs, and all muck was washed out, there being practically no starch remaining.

Examination was then made of both lots with the microscope, which showed minute particles of muck and starch, respectively, adhering thickly all over the outer membrane of the eggs, thus preventing, as Prof. Reighard has shown, the eggs from coming into immediate contact with each other, and thus preventing adhesion. Both lots were worked entirely separate, not being doubled up with others, and showed as near as could be judged by guage measurements a nearly equal percentage of good eggs, about 9½ per cent. above the average of the house, the muck eggs being the best.

On April 16th Henry Curtis, John Dukes and Fred Miller were each furnished with starch and muck and fully instructed in the use of each. The muck was cut down to one quart to the keg, which prevented adhesion. All these spawn takers reported that it required almost constant work to keep the starch from settling into a hard mass, and that it required more work than the old way, while the muck gave no trouble at all, the eggs and muck being simply agitated gently just before introducing a new lot of eggs.

Mr. Curtis finding that the starch settled into a mass unless frequently stirred, worked a considerable portion of it out of the keg. These eggs turned out very fine. Oscar Betts took three jars, about ten quarts, on the 17th, with starch and reported much trouble, but the

eggs were fine. This closed the taking of eggs in starch solution. Eleven jars were taken in all. Thirty-two were taken in the muck solution.

A slight accident in doubling up sample jars treated in the old way prevent exact records of the percentage hatched from eggs taken the same day by the three processes, but a comparison of those taken in muck and starch, and all the other eggs in the house, showed an advantage for the two former of from 7 to 8 per cent., the measurements being taken with the eggs in the jars by guage, the muck treated eggs, as a whole, being the best.

An experiment made after the egg collecting season had closed showed that the addition of about ten per cent. of muck to the starch entirely prevented the starch from settling in a hard mass.

The muck was prepared by taking black muck from the shores of a pond near by, thoroughly mixing to a very thin solution with water, letting the vessel set about half a minute to settle out the coarser and heavier particles, then decanting off the water holding the fine particles in solution, which was left to settle, when the nearly clear water was poured off, the muck being then rubbed through a fine wire screen, when it was ready for use.

The process is very simple, and the muck ready for use easily produced in large quantities.

Whatever credit is due in the success of these experiments much of it belongs to Professor Reighard, whose able papers, published by The Michigan Fish Commission and profusely illustrated in their annual reports, have been of great service to us in the handling of the eggs of the pike perch. Through them, and assisted by the microscope, I have been able to instruct our spawn takers and impress thoroughly on their minds the great importance of using continual care in the taking, impregnating and handling of all kinds of eggs. This work is bearing good fruit as will be seen in the percentage of pike perch eggs hatched this season.

FISH CULTURE AND FISH PROTECTION.

THE CHINOOK SALMON.

(*Oncorhynchus chouica*; *Salmo quinnat.*)

ITS NON-FEEDING HABITS IN FRESH WATERS.

BY LIVINGSTON STONE.

It is an admirable provision of nature that the great armies of anadromous fish that annually ascend fresh-water streams to spawn, where there is, practically speaking, no food for them, should be so constituted that they are not obliged, in order to sustain life, to feed in fresh water. Mammals are said to be more ravenous than ever at corresponding periods; but in the case of anadromous fishes, and possibly of almost all fishes at the spawning season that congregate in large numbers over limited areas, a wonderful exception is made in their favor, in consequence of which they are not only not obliged, in order to support life, to feed where there is no food, but, in the case of Chinook salmon (*Oncorhynchus chouica*), their alimentary organs are so modified at the spawning season that they could not eat if they would; and in consequence of this again they probably do not suffer from hunger, for if the ability to eat be removed, by natural causes, we expect nature to remove also the desire to eat. One can hardly help wishing that industrial armies had also been included in this exception at all seasons of the year.

That such a provision of nature in the case of fishes is necessary—is absolutely indispensable, indeed—is obvious. The often-repeated story of salmon so thick

in fresh-water streams that one could cross the stream on their backs if he could keep his balance, is true. The writer has seen salmon like that scores of times. It happens indeed every year in all good salmon streams where the primeval abundance of the fish has not been reduced by human agency. Now, imagine all these streams filled, as they are every spawning season, for weeks and months, with thousands, yes, hundreds of thousands of salmon, all crowded together where there is no food for them, and suppose at the same time that it was necessary to their existence to have food. What would be the result? The result would inevitably be that they would soon be driven wild with hunger, and would doubtless in their desperate extremity endeavor, if possible, to return to the ocean. Later on, if they continued to stay in fresh water, they would die of starvation, before the days of their spawning were accomplished, and ultimately the race would in consequence become extinct.

It is evident therefore that the salmon must be enabled to live without food in their fresh-water spawning streams. Otherwise it would be simply suicidal for them to go up the streams to spawn. In other words, if the salmon must of necessity go where there is no food, they must also of necessity be provided with the power of living without food.

The common objection to the statement that salmon do not feed in fresh water, is one that comes up at once in every mind instinctively, namely, that it is not natural for an active creature like a salmon to go without food for so long a period as the salmon have to. The argument, put concisely, is that it is unnatural that they should live so long as they do in fresh water without feeding, and consequently it cannot be that they do not feed there. The reply is that it is much more unnatural that, being compelled to feed in order to sustain life, the salmon should be sent into places to stay for months where there is no food to be had. This would be un-

natural indeed. On the other hand is it not the most natural thing in the world, since the salmon must of necessity be sent up into rivers where there is no food for them, that they should be so constituted that they should neither be starved to death nor tortured by hunger for want of food? Let us look now at some facts bearing upon the question. Some years ago, a large salmon hatching station was built on the Clackamas River in Oregon, and each year a rack was constructed across the river to prevent the ascending salmon from going up the river beyond the station.

In the year 1888 the rack was put across the river in March, and during the summer of that year there were, it is safe to say, upward of 5,000 full grown salmon (*Oncorhynchus chouica*) in sight below the rack. The salmon did not begin to spawn till the middle of September. The great body of these fish were there three months, many of them four months, and some of them five months. During all that summer there was not a moment, night or day, when there were not hundreds of these fish struggling to get past or through the obstruction in front of them, and in all that time there was not visible food enough where they were in the river to provide them with an ounce of food a-piece once a week. In one place the salmon were so thick that a person standing on the rack could with an ordinary carriage whip reach 500 full grown salmon averaging 20 lbs. a-piece in weight, and all of them actively struggling all the time to hold their places against the current. No food whatever was there. No appreciable amount of food could have come down through the rack to them. No food could they possibly have had except such microscopic nutriment as may have existed in the water, and there must have been only infinitesimally small rations of this, when divided up among so many thousand pounds of fish. The only conclusion left is that they must have lived several months practically without eating. There is no question whatever about these facts.

The writer saw the salmon below the Clackamas rack almost every day during the summer of '88. Hundreds of ether people saw them, too. The same thing has happened every year except that there are not so many fish now and they are not stopped so early in the year. The same thing happens every year at the McCloud River in California, where the U. S. Fish Commission has its salmon breeding station, named after Prof. Baird, which the writer has had charge of and where he has watched the salmon for nearly twenty seasons. The salmon do not feed in these streams, or if they do their food is invisible. The same thing happens every year in Rogue River, Oregon, where Mr. R. D. Hume has had for over fifteen years a salmon hatchery on a large scale. Mr. Hume says in his little pamphlet ("Salmon of the Pacific Coast," p. 25) that "it has been the custom at his hatching pond to hold salmon nearly four months, even after they had been held in the river for some time prior to being placed in the pond, and this without supplying them with any sort of food." Many more instances might be furnished of salmon living a long time in fresh water without eating, but those just given would seem to be sufficient. It may be mentioned, however, as incidentally confirming this truth, that although hundreds of salmon have been found with absolutely nothing in their stomachs, not a single instance has ever come to light, at least to the writer's knowledge, of a genuine Chinook salmon being caught any considerable distance above tide water with a full stomach. Futhermore, although thousands of salmon have been known to live several months without eating, not a single case has ever been produced to show that a salmon has not been able to live in fresh water without eating.

It does seem impossible that any creature above the grade of reptiles could live so long and keep so active without eating. It does seem impossible, and hence people argue that "being impossible, it cannot be true,"

but it is a well-known principle of logic that an *a priori* argument like that has no weight whatever against the argument of one unanswerable fact. No *a priori* argument based on the general principle that animals cannot live for months without eating can hold for a moment against actual well-authenticated facts that prove that salmon have so lived without eating, and the Clackamas, McCloud and Rogue River hatcheries furnish these facts without limit and with overwhelming conclusiveness. It is not claimed that the salmon thrive and get fat on this way of living. On the contrary, they get very weak and finally very much emaciated in fresh water. From the moment they pass above tide water they begin to fall off in weight, appearance and general condition, and they never under any circumstances whatever improve their condition afterward. They go on getting weaker and thinner. Every day their blood grows less red and less abundant, until at last their great store of strong red blood that they brought from the sea almost entirely disappears. Every day the rich layers of fat between their flakes of flesh become less noticeable till they disappear also. The dark rich pink of the flesh itself changes to a dirty white. Even their scales are absorbed into the body. Everything about their appearance indicates that a tremendous draft is being made upon their physical organization. It is without doubt the draft that nature is making upon their flesh to keep their vital organs in the activity necessary to sustain life, and to develope the growing seed that will replenish the next generation. For here, let me also say, it is not claimed because salmon live without eating, that there is nothing whatever to keep their vital forces in action. This would indeed be incredible. This would be having a fire without fuel, an effect without a cause. It would be quite as absurd as the perpetual motion theory—indeed, it would be, in a sense, a realization of perpetual motion. The fire must have fuel, the vital processes going on within the fish must

be sustained by some supply of nutriment—this must be admitted, but this supply does not come from outside the fish in the form of food. It comes from within the fish. It is the blood, the fat, the superfluous flesh that the salmon brings from the ocean in his own body that he lives on in fresh water, and that enables him to sustain life so long without taking food from outside into his stomach, and this explains—indeed it must explain—why salmon do not have to feed in fresh water.

It was remaked near the beginning of this paper that “the alimentary organs of the salmon are so modified at the spawning season that they could not eat if they would.” This is easily verified. If any one will examine the viscera of a Chinook salmon, caught well above tide and near the spawning season, he will find that the stomach and throat of the fish are singularly contracted, so much so indeed that one cannot push one's finger down the throat without lacerating the tissues, while the stomach is so shrunken that it will not hold a walnut. If it is very near the spawning season he will find the stomach still more contracted and always absolutely empty, with the exception of about half a teaspoonful of a yellowish, bilious-looking fluid.

Having noticed the good natured controversy going on in the sporting papers about salmon not eating in fresh water, I began last fall to examine some of those that were caught at this station (Baird, Cal.), with especial reference to this question, intending at first to try 100 fish. We did, however, examine the stomachs of only 66 and then we stopped, because they were all exactly alike, and I was convinced that if we had tried 100 or 100,000 they would all have been the same. In every one of them the throats were very much contracted, the stomachs very much shrunken, and all entirely empty with the exception of the yellowish looking fluid just mentioned. As to the throat and stomach, every fish was an exact counterpart of all the rest.

Here we have another admirable natural adaptation

to circumstances. Since the salmon are sent into places where there is no food for them to eat, nature kindly takes away their ability to eat and also their desire to eat. If it were not for this wonderful adaptation of nature it seems probable that the salmon, retaining their appetites, would become frantic with the ravenousness of hunger, and abandoning the mission on which they were sent would, regardless of everything else, race back to the ocean to satisfy their hunger on the well-filled stores of food that they undoubtedly well remember leaving. Then, alas for their posterity. There would never be any

The most grateful minded man that I ever heard of was one who, after he had lost every earthly possession, even his last crust of bread, thanked the Lord that he had not lost his appetite. It seems to me a subject both to ourselves and to the salmon of sincere gratitude that the fish *do* lose their appetites when they start on their mission through foodless streams to reproduce their species.

It looks now as if it were pretty well settled that salmon do not feed in fresh water, but when the inquisitors thought they had it all settled about the revolution of the earth by making Galileo retract his statement that the earth moved, the famous astronomer as he was being led away, was heard to murmur under his breath, "It *does* move," and now that it seems to be all settled so nicely about salmon not feeding in fresh water, I imagine I hear more than one veteran salmon hanger say, "They *do* feed in fresh water." I admit it. I would be the last one to deny it, for not only do I know of enough instances of salmon being caught in fresh water with food in their stomachs, to make it folly to deny it, but I have seen the food in their stomachs myself. Last July in particular (July, 1893), I examined the stomach of a salmon caught in the McCloud River about six weeks before spawning season, which had in it four salmon eggs, and the newly

pulverized remains of several insects and larvæ. The salmon eggs came, of course, from the hook that caught it, but the insects it had doubtless picked up from the water in its usual manner of feeding. I must admit therefore that it is undeniable that food is taken by salmon in fresh water. It will be found on examination, however, in every instance where anything is discovered in the stomach of a salmon caught much above tide water, that the food is in very small quantities and composed of very small objects, such as would easily slip down a very small throat and enter a very small stomach, and satisfy only a very small appetite—not enough by any means to disprove the fact that the salmon might, if necessary, have lived without it, but enough nevertheless to prove the fact that salmon do actually feed in fresh water.

The truth is that the evidence compels us to admit both of these apparently conflicting facts, namely, that salmon can and do live for months in fresh water without food, and that they can and do feed during some of the time that they are in fresh water. These two facts are not necessarily conflicting, however, though they may seem so at first. The writer's own theory is that as soon as the salmon, coming from the sea, strike fresh water, their appetite begins to weaken, their throats begin to narrow, and their stomachs begin to shrink. This does not at first, however, entirely prevent them from feeding, but it changes them enough to enable them to overcome the temptation to return to their well-stocked feeding grounds in the salt ocean, and the longer they remain in fresh water the greater the changes become, and the temptation to turn back for food correspondingly less. There is probably no one specified time when an abrupt change comes which deprives them in an instant of their ability and their desire to feed, but in the writer's opinion, the transformation comes on gradually, increasing constantly day by day

from the time that they leave tide water till at the near approach of the spawning season their throats and stomachs become entirely incapacitated for receiving food, and the desire and ability to feed leave them entirely, but, notwithstanding their scanty supply at first and their entire abstinence afterward, the great reserve of superfluous flesh and blood which they bring with them in their own bodies from the bountiful ocean, enables them with little or no food in their stomachs to keep their vital organs in vigorous activity until their momentuous mission up the fresh water streams is accomplished.

Allow me in conclusion to make the precautionary statement that where the word salmon is used in this paper, the word is intended to refer to only one variety of salmon, namely *Oncorhynchus chouica*, commonly known as the Chinook salmon, Columbia River salmon and Quinnat salmon.

RELATIONS OF THE COMMUNITY TO THE FISHERIES.

(A paper read before the American Fisheries Society, 1894.)

As preliminary to the discussion of this topic, it is well to bring to the attention of this Society the extent and importance of our fishing industries. The United States Commission has recently completed and is now publishing a paper on the "STATISTICS OF THE FISHERIES OF THE UNITED STATES." By reference to this report you will find that the commercial fisheries of this country give employment to 182,407 persons; represents an investment in vessels, boats, fishing gear, buildings, wharves and other property, of \$58,355,000, and yield products of the annual value of \$45,000,000 in first hands. The cost to the consumer is probably three times the amount received by the fishermen, or about \$130,000,000 per annum. If we add to the number of persons actually employed in the fisheries those who are dependent upon them, as also the large number of people engaged in various other occupations which are directly or indirectly dependent upon the fisheries, it is safe to assume that the fishing industries of the United States furnish the means of support to over 1,000,000 of the inhabitants of this country, or to one person in every sixty-five of population.

The conditions under which our sea coast and great lake fisheries are prosecuted are peculiar, and without parallel when we compare them with the industries of the land. Individual ownership and control is the foundation upon which rests all of our industrial enter-

prises other than those pertaining to the fisheries. The laws give full protection, and every one is free to enjoy the fruits of his enterprise and labor. The farmer plants in the full assurance that he and not another will reap the harvest. He improves his land and increases his investments, knowing that the greater usufruct determined by the exercise of intelligence and energy will inure to his own benefit. What is true of agriculture is alike true of the various industrial enterprises, manufacturing, mining, and commercial, which engage our people. We may safely trust their administration to the intelligence and enterprise of those engaged in them.

In respect to our great commercial fisheries, the conditions are entirely different. Individual ownership of the open waters is not practicable, even if it were desirable; nor can we safely trust to the individual to establish or conserve conditions which are necessary to maintain supply. Indeed it is not reasonable to expect that he will undertake to sow the seeds of a harvest which other men may gather. Intent on gain, he will fail to recognize or appreciate any deterioration of the fisheries, so long as his operations yield him a fair return for labor and investment.

The ownership of the waters is in the State, and they should be farmed for the general use and benefit.

The right of fishing of the individual is subject to the paramount right of the State to prescribe the conditions under which such right may be exercised.

Equal privileges under the law and no invidious discriminations or unnecessary restraints upon the enterprises of the fishermen should characterize the policy of the State in enacting and enforcing such regulations as may be found necessary for the conservation of the fisheries.

The right of the community, through its representatives, to regulate the fisheries and to prescribe the conditions under which individuals may exercise the right

or privilege of fishing being conceded, we must be prepared to admit that the power of the State should be exercised with the most careful conservatism and consideration of the immediate interests to be affected.

The community is concerned only as to the abundance, quality and price of the products drawn from the waters. It is indifferent as to the methods, except in so far as they affect the quantity or condition of the fish supply. When conditions are impaired; when there is evidently a decrease in the fish food supply, then it is incumbent upon the State to adopt measures to arrest the decline. This policy is in the interest not of the community only but also of those who are engaged in the fisheries, or who are occupied with enterprises and industries which are related to them, since the security and profit of investments depend upon the assiduity with which we guard the fisheries from the operation of causes which may determine permanent deterioration. The necessity of intervention to this end being satisfactorily established, we may attempt the regeneration by artificial propagation on a sufficiently extensive scale to repair the waste by natural casualties and man's operations, or we may so regulate the times, methods and apparatus of the fisheries as to permit natural reproduction under the most favorable conditions, or we may resort to both means, artificial propagation being pushed as far as practicable in order to ease or release the restraints upon the operations of the fishermen.

Undoubtedly the rational method of dealing with the fisheries is to supplement, as far as possible by artificial propagation, any deficiency in natural reproduction arising through the operations of the fisheries. Where this can be shown to be adequate, there should be no further interference with the fisheries by legal restrictions or prohibitions than is necessary to insure equal privileges under the law in the exercise of the common right of fishing, or to prohibit or restrict the use of

methods or apparatus that experience has shown to be unnecessarily wasteful or destructive. Whether we can rely entirely upon artificial propagation to compensate for the destruction effected through the agency of man, I am strongly inclined to doubt. The value of this resource as a sufficient means of maintaining production and at the same time imposing little or no restraint upon the fishing enterprises is very forcibly illustrated by the history of the shad fisheries of the Atlantic coast rivers since 1880. This is a species which must find access to the fresh waters of the rivers in order to accomplish reproduction. Where the streams are unobstructed it pushes its way up hundreds of miles from tidewater in order to find suitable spawning grounds. It does not spawn in the brackish or salt waters, and if it did the eggs would prove infertile. Under the present conditions of the shad fisheries, but a very small proportion of the shad approaching our rivers under the constraint of reproduction ever find their way to their spawning grounds in the rivers. Fully eighty per cent. are taken in the brackish water of the estuaries of our rivers or on the shores of the ocean or the great bays which indent the shoreline. Under these conditions, we are compelled to depend largely, if not entirely upon artificial propagation to repair the annual waste by natural casualties and the fisheries. This great fishery is under conditions as artificial as is the corn or the wheat crop. Its permanence and such marked improvement as has taken place since 1880 in the annual value of the product is unquestionably to be attributed to the extensive measures of artificial propagation which have been conducted with this species by the Fish Commissions of the different States on the Atlantic Sea Board and by the United States Fish Commission.

Since 1885 there has been a steady and progressive increase in the annual value of the shad taken on the

Atlantic Sea Board, and at present the amount and value of the annual product is nearly double what it was in 1880.

It might appear that the development of the shad fishery as disclosed by the statistics of production from 1880 to 1892, inclusive, would indicate that artificial propagation may be relied upon as adequate to maintain production, even under the most adverse conditions. We must consider, however, that the ability to maintain supply by this means can only continue so long as a sufficient number of shad are permitted to pass into the rivers to furnish the basis of a supply of eggs necessary to carry on the work. I cannot disguise the fact that every year we have more reason to apprehend that the existing fishing conducted in the brackish and salt waters will eventually so reduce the number running into the rivers that we will no longer be able to rely upon artificial propagation, unless aided by protective regulations and legal restraints upon the pound net fishing, not only in the rivers but also in the bays.

When we turn to the important salmon fisheries of the Columbia River, we find the same conditions not only impending but accomplished. Comparing the average catch for the five years beginning with 1889 with the previous five years, we find that there has been an average reduction of 150,000 cases in the take of salmon, and a reduced annual value of not less than three quarters of a million of dollars. This is undoubtedly to be attributed to the fact that the appliances for the capture of salmon in the lower river are so numerous, so complete, and so fully occupy every channel of approach that at present very few salmon are able to reach their spawning grounds in the upper rivers. Now what is impending or accomplished in the present conditions of the shad and salmon fisheries certainly will occur in regard to every species the spawning grounds of which are in the rivers. For it is evident, in regard

to any of them, the methods of fishing may be such as in a large measure to shut them off from their spawning grounds. Under such a state of things artificial propagation on adequate scale could be no longer carried on for the reason that we would have no ripe fish from which to draw supplies of eggs.

Now, what is true in regard to our river species is alike true in regard to all the coast species whenever the operations of the fisheries are such as to intercept in considerable measure the movement of mature fish to their spawning grounds. The necessity of the regulation of the fisheries by law is apparent in every case where a knowledge of the habits and movements of the fishes of our coastal waters is such as to indicate that existing methods do seriously interrupt or interfere with their approach to their spawning grounds. What shall be the character of the protective regulations required in the interest of the fisheries must be based upon a complete knowledge of the life history of the species. In regard to many of our coastal species, we are approaching a time when it will be possible to give conclusive information upon this subject which may serve as a basis for such regulations as the conditions of the fisheries may require.

You are all aware that the sentiment as to the necessity of protective regulations in reference to the coast fisheries is now active and aggressive. When the allegation is made that there is a material decline in the products of our fisheries, the fishermen who fear the results of hasty legislation based upon inconclusive data reasonably ask for the evidence as to the decline in the coast fisheries which warrants the attempt to interfere by law with interests which employ a large number of men, a large investment of capital, and which yield products which are very important to the community.

In considering the statistics of our fisheries we may consider the fisheries as a whole and by a comparison

of the census taken at intervals of a term of years, determine conclusively the facts as to aggregate increase or decrease in the period considered. Again, we may make the comparison by geographical divisions, seeking in this way to arrive at local fluctuations which are not indicated in the general aggregate; and again we may take up the special fisheries for certain important economic species, and by comparison of products determine the fact of increase or decrease in regard to this particular fishery.

I hold in my hand a table giving the comparative summary of the fisheries of the entire United States for the years 1880 and 1892.

	Persons Employed		Capital Invested		Value of products	
	1880.	1892.*	1880.	1892.	1880.	1892.
New England States.	37,043	37,025	\$19,037,607	\$19,859,508	\$12,500,071	\$12,445,569
Middle Atlantic States	59,853	90,685	12,685,341	10,405,151	16,360,517	10,047,580
South Atlantic States	7,546	16,138	695,160	1,693,076	1,256,578	1,580,894
Gulf States.....	5,131	12,019	545,584	2,093,080	1,227,544	2,490,405
Pacific States.....	16,803	16,771	2,748,383	8,873,813	5,545,588	7,258,025
Great Lakes Region.....	5,050	9,738	1,345,975	5,478,080	1,784,050	2,471,355
Grand total	131,426	182,376	37,958,040	58,302,718	38,683,348	45,312,818

This table is taken from a report on the statistics of the fisheries of the United States, prepared in the division of Fisheries of the United States Fish Commission, and based upon field investigations conducted by the employees of the Commission in part under the direction of Mr. J. W. Collins when Assistant in charge of the Division of Fisheries of the Commission, and in part by his successor, Mr. H. M. Smith, now in charge of that work. The data are taken in large part from the books of the fishermen. They have been collated with care and judgment, and may be relied upon to

*This year is placed at the head of the columns because it is the most recent one to which the statistics relate, and the one to which most of the figures apply. The data for the New England, Middle Atlantic and Pacific States are for that year, those for the South Atlantic States are for 1891, and those for the Gulf region and Great Lakes are for 1890.

furnish as accurate a statistical presentation of the conditions of the fisheries as can be obtained with the means and resources at the command of the Fish Commission.

By reference to this table you will find that in 1892 the number of persons employed in all branches of the fisheries and related industries in all parts of the United States has increased 38.77 per cent. as compared with the number employed in 1888. The capital invested has increased 53.43 per cent. whilst the total value of the products of the fisheries has increased but 17.14 per cent. This indicates in a general way that the fisheries in 1892, taken as a whole, have not been so productive in proportion to the number of persons employed and capital invested as they were in 1880. We are, however, liable to err if we attempt to apply this general conclusion to the case of any particular fishery, though the general fact is broadly emphasized that our fisheries do not now yield the profitable return to individuals and to investments that they did in 1880.

Referring to this same table and considering the statistics of the fisheries by geographical divisions, we find that the fisheries of the New England States as a whole are practically unchanged since 1880. The number of persons employed is slightly less: the capital invested has been reduced less than one half of one per cent. while the value of the products has increased one half of one per cent.

For the Middle Atlantic States we find the number of persons employed has increased 51 per cent.; the capital invested 53 per cent.; while the increased value of the products is only 16 $\frac{1}{2}$ per cent. For the South Atlantic States the number of persons employed has more than doubled, being 113 per cent.; the capital invested has increased 14 per cent.; while the value of the products rises to a little above 26 per cent.

In the Gulf States, the percentage of increase in persons employed is 137.95; the capital invested, 82; and the increased value of the products, 103.

In the Pacific States the number of persons employed is about the same as in 1880; the investment of capital has more than doubled, while the aggregate increase in value of products amounts to 30 per cent.

In the Great Lake States the percentage of increase in persons employed is 92.63; of capital invested 232.7; the increased value of the products rising only to 38.52 per cent.

The figures for the Great Lakes are very significant. With nearly double the number of persons employed in the fisheries, and with upward of 50 per cent. increase in the capital invested, there is but 17 per cent. increase in the total value of the product. This comparison is more significant when we consider that the increased production has been brought about by the utilization for market supply of species of fish such as the herring and others which constitute but an insignificant portion of the total products of 1880. The most important fishery of 1880—that of the whitefish—has vastly deteriorated, the take in 1892 being considerably less than one half of the catch of 1880. And this result has arrived in spite of the fact that artificial propagation of the whitefish has been carried on on a stupendous scale by the different State Commissions and by the United States Commission on all of the great lakes. This deterioration in the number of whitefish is clearly to be attributed to the methods employed, and the necessity of some restraint upon these methods is imperatively indicated, not only in the general interest of the consumer but in the interest of the fisheries themselves.

I would now call your attention to a table of the comparative statistics of the catch of certain species of fish in 1880 and 1892, taken from the same report:

COMPARATIVE STATISTICS OF THE CATCH OF CERTAIN
PRODUCTS IN 1880 AND 1892.

	1880.		1892.		Increase or decrease.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives	45,684,333	\$526,546	59,176,183	\$554,740	+ 13,491,850	+ \$28,194
Bluefish.	14,707,708	366,756	15,957,836	637,305	+ 1,250,128	+ 270,532
Cod.	119,137,350	3,475,106	92,643,811	2,996,661	- 26,493,539	- 478,415
Lobsters	20,238,683	631,769	23,301,149	1,050,677	+ 3,062,466	+ 418,908
Mackerel.	73,317,553	1,8 3,910	17,041,736	1,102,651	- 56,275,827	- 761,250
Mullet	6,701,950	225,000	21,214,840	387,916	+ 14,512,890	+ 162,907
Salmon	51,633,824	1,086,339	93,826,527	3,730,416	+ 42,192,703	+ 2,644,077
Sea Bass.	2,642,650	113,176	8,401,553	355,602	+ 5,788,903	+ 242,426
Spanish Mackerel	1,887,423	131,639	1,773,081	129,259	- 114,344	- 2,380
Squeteague.	15,463,560	437,022	22,340,433	708,830	+ 6,876,873	+ 271,868

In this table we have arranged by sections the statistics of a number of economic species which furnish the basis of important fisheries. We will take first the alewives or river herring, instituting always comparisons between 1880 and 1892. We find for this species an increased product of 59,000,000 pounds. And referring the increase and decrease to the different geographical sections in which this fishery is prosecuted, we find the increase wholly in the Middle and South Atlantic States, the New England product having fallen off about two and a half million pound. It would appear, therefore, that so far as this fishery is concerned the methods of fishing have had no influence upon the product, and that therefore no restrictions are necessary in regard to this species. As a matter of fact the capture of the herring is made largely in pound nets and in seines. When the fish are taken in the pounds many of them, both males and females, are ripe, and crowded together as they are, involuntary reproduction is accomplished, since the squeezing and crowding of the multitude in the net accomplish precisely the same process that we do in artificial propagation. The eggs under these conditions are fertilized in vast numbers—being adhesive and floating off with the tide, they attach themselves not only to the walls of the net but to every available

object in the tide way—and for this reason I am inclined to think that so far as the alewives are concerned the pound net fishing instead of working any disadvantage is actually improving the condition of this fishery all the time

The next species in order is the bluefish. The census of 1880 gives the total catch of this species for the entire coast at 14,707,000 pounds. The catch of 1892 reaches nearly 16,000,000, being 1,250,000 pounds in excess of the catch of 1880. Considerig the data by geographical sections we find that the decrease in this species in the New England States since 1880 has amounted to 4,223,000 pounds. The largest increase of 4,321,000 pounds is in the Middle Atlantic States. The increase for the South Atlantic States is 602,000 pounds; for the Gulf States 545,000 pounds, this being a new fishery for that section. Whether the vast decrease in the New England States is to be attributed to the methods employed there or is the result of the larger and growing catch in the Middle and South Atlantic States, is a matter about which we cannot at present form a conclusive opinion.

The cod fishery is prosecuted mainly in the New England and Midddle Atlantic States; there being, however, an important and growing fishery in the North Pacific. Considering the fishery as a whole, we find a falling off of 26,500,000 pounds in product as compared with 1880, the decline being the largest in the New England States.

It is to be noted in connection with this fishery that the species is taken almost entirely, if not entirely, by hook and line, and the greater proportion in offshore waters. The deterioration cannot, therefore, in this case be attributed to any of the different forms of apparatus that are used in our coast waters.

In the case of the lobsters we find an increase of 3,000,000 pounds in the product of 1892 as compared

with 1880, which is to be attributed probably in part to the stringent laws regulating this fishery which are now in operation, and in part to the great increase in the number of persons employed in the fishery.

The mackerel is another important fishery to which I wish to call your attention. We find a decrease in this fishery in 1892 as compared with 1880 of 56,275,000 pounds. The great fluctuations in this fishery from year to year are inexplicable at the present time. In the absence of specific knowledge as to the spawning grounds of the mackerel and the conditions under which spawning takes place, we are not prepared to attribute any influence to methods as now pursued in affecting the results of the fisheries.

The mullet fishery, which is more important in the South Atlantic and Gulf States, shows an increase of 14,000,000 pounds in 1892 as compared with 1880. This increase, however, has no significance as bearing upon the question of regulation, from the fact that it has arisen by the development of new grounds in the South Atlantic and Gulf States, and by more active fishing in the Middle Atlantic States.

The salmon, you know, is one of the most important economic species of the West coast. We find in this case an increased production in 1892 of 3,730,000 pounds as compared with 1880. This certainly furnishes no argument in favor of unrestrained fishing so far as it relates to this species. The increase is due entirely to the development of new grounds, and has been accompanied by an alarming decrease in those rivers which in 1880 furnished a large part of the salmon for market. I refer particularly to the Sacramento and the Columbia Rivers, where there has been marked deterioration in the fisheries, clearly the result of the fishing operations.

The sea bass, or black fish of New Jersey, shows an increased production of 5,758,000 pounds, which is

pretty equally distributed to the three geographical sections of the Atlantic Sea Board. There is no decrease indicated anywhere in either the New England, the Middle or the South Atlantic States.

The Spanish Mackerel is an important economic species, the greater supplies of which during 1880 were drawn from the Chesapeake region. Since that time the fisheries have been extended and largely developed in the South Atlantic and Gulf States. In spite of the productive fishing grounds of the Gulf States, we find a diminished production of 114,000 pounds in 1892 as compared with 1880, the production of the Middle Atlantic States having fallen from 1,852,000 pounds to 976,008 pounds. This fishery, I think, furnishes a marked example of the detrimental influence that unrestrained pound net fishing may exercise upon a coast species. The larger proportion of the catch of Spanish mackerel in the Middle Atlantic States is in the Chesapeake Bay by pound nets on the eastern and western shores. The mackerel enter the Bay to spawn; the pound nets are set in the track of the run; the fish taken are nearly all spawning fish; and the disposition of the apparatus of capture is such as to intercept them almost entirely in their approach to waters in which to spawn. In this way the great deterioration in the mackerel fishery of the Chesapeake is clearly to be attributed to the pound net fishing. This species, however, furnishes a clear and well-defined instance of deterioration which we can fairly attribute to the operations of the fishermen.

The last species to which I wish to call your attention is the squeteague. We find for this species an increase of 6,876,000 pounds as compared with 1880; the increase being general for all the geographical sections in which the fisheries are prosecuted.

In considering the question which I have brought to your attention in this paper, it will be interesting to

note the advance of public sentiment in Great Britain as to the necessity of protection to the sea fisheries in territorial waters since the publication of the report of the Trawling Commission of 1863, of which Professor Huxley was president. At that time there was little or no knowledge of the life history or the spawning habits of the different species which were the object of the commercial fisheries. There were no statistics upon which to build satisfactory conclusions. The commission was forced to rely entirely upon the conflicting testimony of those engaged in the fishing interests. In speaking of the perplexities and embarrassments as to the conclusions to be drawn from the conflicting testimony of the fishermen, the Commission states as follows :

" Fishermen as a class are exceedingly unobservant of anything about fish which is not absolutely forced upon them by their daily avocations, and they are consequently not only prone to adopt every belief which seems to tell in their own favor but they are disposed to depreciate a comparison of the present with the past. Nor in certain localities do they lack the additional temptation to make the worst of the present, offered by the hope that strong statements may lead the State to interfere in their favor with dangerous competitors."

The general conclusion of the Commission upon which the advocates of free fishing in this country base their protests against any interference whatever by the state in controlling their operations is as follows :

" I. We advise that all Acts of Parliament which profess to regulate or restrict the modes of fishing pursued in the open sea be repealed ; and that unrestricted freedom of fishing be permitted hereafter.

" II. With respect to inshore fishing, although the evidence, so far as it is conclusive, appears to us to prove that the taking of small and immature fish has not yet produced any injurious effect upon the fisheries,

it is undoubtedly possible that, by the use of improved engines, the destruction of fry might reach such a pitch as to bear a large instead of, as at present, an insignificant ratio of the destruction effected by the natural enemies of fish, and by conditions unfavorable to their existence,

“The existence of such a state of things, however, could only be determined by the examination of trustworthy statistics of the fisheries in question, extending over a considerable number of years. Should it ever be satisfactorily proved to have arisen, we conceive that the best remedial measure would be to place a restriction upon the size of the fish permitted to be brought ashore, and subject the possessor of fish below a certain specified size to penalties; but to avoid interfering with the implements of fishermen or with their methods of fishing.

“For the present, we advise that all Acts of Parliament which profess to regulate or restrict the methods of fishing pursued inshore be repealed; with the exceptions, purely on grounds of police, of the local Act regulating pilchard fishing at St. Ives; and, for that part of Loch Fyne which lies above Otter Spit, of the Act prohibiting trawling for herrings in Scotland.”

In 1878, fifteen years after the investigation by Prof. Huxley and his associates, a second commission was appointed to inquire into (1) the use of the trawl net and the beam trawl in the English seas, and the territorial waters of England and Wales; (2), into the use of the seine nets and the ground seine on the coast of Cornwall and elsewhere; and (3), into the alleged destruction of fry and spawn of sea fish in estuaries of rivers and bays by the above and other modes of fishing.

This Commission, of which Mr. Frank Buckland was chairman, reached the same general conclusion in regard to the decrease in the supply of fish arising by means of fishing operations as did the previous Commission of

1863. They, however, took strong grounds for establishing legislative restrictions for fixed engines, under which title is included the different pounds, weirs, traps and stake nets, which are in common use on our own shores. The views of the Commission in reference to this matter are of sufficient importance to warrant their quotation in full.

LEGISLATIVE REGULATIONS FOR FIXED ENGINES.

"So far as the fish themselves are concerned, it is not a matter of much importance whether they are taken by a fixed engine or by a movable net. Provided that the use of these engines is not injurious to the fishing, they ought apparently to stand or fall together; and we are inclined, in fact, to arrive at this conclusion with respect to all those engines which are either temporarily fixed to the soil, or which are merely attached, like the stow net, to an anchored boat. But as we have already stated there is another kind of fixed engine, permanently attached to the soil, which seems to us to require much more serious consideration.

"From a fishery point of view there is this difference between a fixed engine and a movable net. The fixed engine is always on the spot. It regularly works with every tide, requiring no rest and keeping no Sabbath. The movable net, on the contrary, can only be worked by the active labor of the fisherman. Its use, therefore is intermittent, and its destructiveness limited. It is obvious that an engine that is at work with every tide must, or certainly may, catch more fish than a net whose use is limited to the capacity of the fishermen for endurance. The fixed engine, moreover, covers more ground than the movable engine. The fixed engines in Swansea Bay reach across the greater portion of the Bay. They frequently overlap each other. They do not, therefore, like the movable net, take only a propor-

tion of the fish, but they do, or may, take all the fish passing up into that portion of the Bay.

"The names which fixed engines bear sufficiently indicate their antiquity. 'Weirs', 'garths', 'goryds', 'baulks' 'hangs', 'butts' and 'kettle nets', are corruptions of Saxon, Celtic and Norman words, and have been handed down by successive generations of fishermen from their Saxon, Celtic and Norman ancestors. But, though the engines are certainly old, their use has never been tolerated. Their erection, except on the sea coast, was reprobated in *Magna Charta*; they have been prohibited by many succeeding statutes; and fixed engines may be said to exist not by virtue of the law but in defiance of law.

"There were two reasons which the Legislature constantly gave in the olden time for putting down these engines. In the first place, they interfered with the navigation; in the next place they gave one fisherman a monopoly of the fishery which was nominally open to all the King's subjects. Fixed engines were, in short, in the first instance, an encroachment on the public rights. Time has in most cases now given their owners a prescriptive right in their use. But the engines were originally an encroachment on the rights of others. The man who erected a fixed engine usually placed it on his own shore. He was usually possessed, therefore, of the soil on which the engine stood. But this is not always the case; the kettle nets in Rye Bay, and we believe many of the hose nets in Bridgewater Bay, are fixed on the property of the Crown; and the same thing is probably true of other fixed engines.

"We understand that in Rye Bay and on the Sussex coast, the Board of Trade, acting on the instigation of the Admiralty, have positively refused to allow the erection of any new fixed nets, or to permit the present nets to remain beyond the lifetime of their present possessors. We see no reason why the same rule should

not be applied to all fixed engines, wherever situate, standing on the property of the Crown. It would perhaps be unjust to apply the same rule to fixed engines on private property. Property acquired by prescription has a prescriptive right to exist ; but even in this case we think that there would be no hardship in compelling the proprietor of a fixed engine to state the nature of the engines which he considered he was entitled to use, and to allow him thenceforward only to use such as had been actually worked during some time in the previous ten years."

The conclusion of the Commission in regard to these forms of apparatus is stated as follows :

1. That fixed engines confer a monopoly upon particular fishermen, which is opposed to the ordinary principles of legislation.
2. That those fixed engines which are erected on foreshore, the property of the Crown, should be abolished on the termination of the existing leases or lives on which they are held.
3. That no new fixed engine should be erected on either public or private property.

Passing now to the Trawling Commission of 1885 which pursued the same line of inquiry as the previous Commission already alluded to, we find the following conclusions and recommendations based upon the results of their labors :

SUMMARY OF CONCLUSIONS.

- I. In territorial waters from the Moray Firth to Grimsby—
 - (a) A falling off of flat fish.
 - (b) A decrease of haddock in certain places.
- II. In offshore waters.
No decrease in the total take of fish in the North Sea, except in the case of soles.

- III. The beam trawl is not destructive to cod or haddock spawn. There is no proof of injury to the spawn of herrings or other edible fish.
- IV. There is no wasteful or unnecessary destruction of immature food fishes by the beam trawl.
- V. The number of fish on particular grounds, especially in narrow waters, may be sensibly diminished by the use of the beam trawl.
- VI. The injury done by the beam trawl to the food of fish is insignificant.
- VII. It has not been proved that the use of the beam trawl is the sole cause of the diminution of fish in territorial waters.
- VIII. In the absence of a proper system of fishery statistics and scientific observations, it is impossible to discover the causes or measure the fluctuations of the fisheries.
- IX. Much avoidable damage has been done to drift nets and haddock lines, particularly by steam trawlers.
- X. Peculiar difficulties attend the recovery by fishermen of compensation under the Sea Fisheries Act, or of civil damages.

RECOMMENDATIONS.

In consequence of these conclusions and of other facts brought before us in the course of our inquiry, we submit the following recommendations to Your Majesty:

- I. That a central authority be created to supervise and control the fisheries of Great Britain, if not of the United Kingdom, and that a sum of money be annually granted to such authority for the purpose of conducting scientific experiments and for collecting fishery statistics.
- II. That in the meantime powers be given to the Scotch Fishery Board similar to those of the

Irish Board, enabling them to make by-laws for the regulation or suspension of beam trawling, or of any other mode of fishing within territorial waters; and that a sum of money be granted annually by the Treasury for the purposes mentioned in the last paragraph.

- III. That a similar authority with similar powers be created for England, and that in the meantime those powers be conferred upon the Secretary of State or President of the Board of Trade.
- IV. That statutory powers and means be given to the fishery authorities to enable them to collect adequate statistics.
- V. That the cruisers serving under the Scotch Fishery Board, whether employed for police or scientific purposes, be replaced by efficient steam vessels.
- VI. That steam trawlers, besides having their number and letters painted on the bow, should also have them painted on the quarter.

Considering this most recent report, it is evident that public sentiment in England, so far as it is expressed in the report of the Trawling Commission of 1885, is far in advance of public sentiment in this country in regard to the same subject.

In conclusion, I desire to say, that in the discussion of this subject, I have aimed to avoid questions or occasions of controversy. I have sought to lay down the fundamental principles upon which it will be necessary to construct such legislation as may be found requisite to remedy actual or prevent impending decrease in our fish supply. No one will dispute the power of the State, having in view the general interest, to prescribe such regulations as may be found expedient. It will be equally conceded that such power should be exercised with the utmost conservatism, and with due

regard to the important interests concerned. It will not be denied, I presume, that the effect of unrestrained fishing in our rivers is to reduce supply, which it is necessary to compensate for, either by artificial propagation or by restrictions in the fishing, or preferably, both combined. This necessity arises from the fact that it is possible in our rivers to intercept or obstruct the fish on their way to their spawning grounds. The further conclusion must be drawn that wherever, in reference to our coast fishes, it can be shown that the methods and locations of the fisheries are such as to obstruct or materially impede access to their spawning grounds, the same results must inevitably happen in reference to these that we have already found to take place in the case of our river species.

The broad fact I wish to impress upon this audience and upon the fishing interests, is this: that the interest of the community is in maintainance of supply, and the interests of the fisheries cannot in any measure be separated from the general interest. Whatever measures are required to increase or maintain production, are as clearly in the interest of the fishermen themselves as in that of the community of which they constitute a part.

M. McDONALD.

Captain Collins said, "Mr. President, I think I can help Colonel McDonald in regard to the statistics he has presented. At the time the investigation was made of the Gulf and South Atlantic States, I was in charge of that department of the United States Fish Commission, and the figures he has given were those of the year 1890. Since that time there has been a system established of getting returns by blanks left with the fishermen, and all the statistics of the Great Lakes were taken in '91, or about that time. I think I am correct in stating that the complete statistics were not taken

for the rest of the Atlantic Coast. I know it has not been covered since 1889. I also know that they have been collected with a great deal of care as relates to certain species for '92 and '93, but I believe that I am correct in saying that these investigations ought to cover all the species. Why I speak of this, is for the reason that Colonel McDonald has said that these papers covered a period of '91 and '92. It is true that these statistics cover some years generally and others specially, and there is no general way that can be taken as a basis for settling this question. It is also true that many of our fisheries fluctuate from year to year and that the statistics for last year will not suffice for this. This I found to be especially the case in Georgia, in the South Atlantic States, as the published reports will show. It will seem that there is a very rapid increase in fishing and also in pound and purse seines, so that if we had complete statistics of the entire interest from Rio Grande to Eastport, Maine, we might have something that would be of value to us. Colonel Marshal McDonald spoke of an increase in the invested capital and the lack of an increase in the products. If he has looked this matter over properly, he will find that a large part of this increase in capitalization is due to the fact that great care is being now taken in the preservation of fish products. Enormous sums of money are spent for refrigerators, and to provide for the preservation of fish when the supply is in excess of the demand. The increase in the capitalization, therefore, can hardly be taken in comparison with the increase of products, as the majority of the increase in money has been spent in these refrigerating houses. I also believe that there is a large increase in the capitalization of the fisheries in the South Atlantic and Gulf States, where a great deal of money has been expended in establishing new fisheries, and also in plants for packing oysters and preserving the products of the

fisheries. All these things should be taken into consideration or else we may be misled in taking general statistics. I have given this matter careful consideration and am satisfied that statistics can be obtained that will be absolutely accurate and will tell the whole truth."

THE FOOD-PROBLEM IN FISHCULTURE.

BY CHAS. G. ATKINS.

Any one reviewing the fishcultural literature of the last few years can but observe that attention has been to a remarkable degree concentrated on subjects pertaining to the nutrition of young fishes. The main question is no longer how shall we obtain the eggs of desirable species, or how shall we impregnate them, or how incubate them, or how many of the fry can we liberate ? but how shall we feed the young fish ?

There appears to be a very general agreement among fishculturists that it is desirable, not to say necessary, that the nutrition of the young fish resulting from artificial operations, should no longer be left to nature and to chance, but should be made the subject of man's most earnest study, and the object of his direct care. The negative of this proposition is hardly maintained by even the most conservative member of the craft. Those who have seemed to array themselves on the negative side, appear to me to be merely maintaining the insufficiency of the methods of feeding which have thus far been brought to their attention.

I may say that for myself, after a careful study of the situation, and of the expressions of other fishculturists, I have reached these three conclusions : first, that the practice of holding the fry of salmon and trout in confinement and feeding them for some months after hatching is a distinct improvement over the practice of liberating them as soon as they can feed : second, that we have a fair prospect of effecting this work with due economy : third, that there is good reason to expect the

best results from feeding with live food. To the latter theme I will devote this paper

In a paper read before this society last year, Mr. Page admonished us that we were allowing European fish-culturists to lead us in this most important branch of the art. This is unquestionably the fact, but I think we need not to hang our heads with shame on that account. The present stock of knowledge in this department and the most advanced achievements have been a natural outgrowth from experience in pond-culture, an industry hardly yet known in America, but one that dates back hundreds of years in Europe, and is followed in some districts on a very large scale. In Bohemia and Silesia there are fish-farms with hundreds of acres of water. At Wittingau, in Bohemia, a single fishculturist, Mr. Joseph Susta, has charge of ponds covering 15,000 acres, a considerable portion of which can be periodically drained and flowed. These great fish-farms were in existence and profitably conducted after a well-established routine many generations before the so-called artificial fishculture had its birth. It was, moreover, a live-food method, though hardly known to be such, even by its practitioners. The introduction of artificial propagation of salmonidae and other fishes, and the general dissemination of interest in the scientific study of animal life during the last 53 years has reacted on the fishculturists, and quickened their faculties of observation, and they have recently made some important discoveries.

One of the most important of these discoveries, made by Mr. Susta of Wittingau, relates to the character of the food of fishes, especially the carp. It used to be held as a dogma that the carp fed mainly on vegetable matter. Even as late as 1863, Raphael Molin, the author of a work of some reputation on "The Rational Culture of Freshwater Fishes," gave this account of the food of the carp: "The carp delights in quiet water with

rich muddy bottom, in which he bores with his head in the search for worms, larvae, &c., on which, together with grass, young rushes, other vegetable substances, animal excrements, swollen barley, kitchen refuse, &c., he subsists." Not satisfied with the results of management based on these theories of the habits of the carp, Susta undertook in 1876 a systematic study of the contents of the alimentary canal of the carp. Hundreds of specimens, from many different ponds, under various systems of feeding, were dissected and the results of the inspection carefully noted, with evident faithfulness and candor. As a result he reached the conclusion that the carp in reality subsists on animal food exclusively; and that the vegetable constituents of the contents of the stomach and intestine could only have been swallowed by accident, and in fact were voided by the fish almost wholly unaffected by digestion.

Susta extended his investigations to other species and found only three sorts which could be considered plant-feeders. He classifies the ordinary European pond-fish aside from the carp, on the basis of their food, into (A) fish of prey: (B) eaters of small animals: (C) vegetarian.

In the category of fish of prey, he names the pike, perch, ruff, (a percoid), pikeperch, brook trout, eelpout (*Lota*), sheat fish (*Silurus*), and eels. As eaters of minute animals, he gives us the maraena (*Coregonus*), crucian carp, tench, gudgeon, and eight other species of cyprinoids. His list of vegetarians comprises only three species, namely, the dobule (*Squalius dobula*, Heck), the roach (*Leuciscus rutilus*, Heck), and the rudd (*Scardinius erythrophthalmus*, Bon), all cyprinoids.

More recently Dr. Otto Zacharias, director of the biological station at Plon, has made similar investigations of the stomach contents of numerous species of fish and reached the conclusion that the above three species are the only vegetarians among them; and the researches

of another German investigator, Dr. Dröscher, of Schwerin, indicate that one of these, the roach, is sometimes largely an animal feeder.

It is probable, therefore, that we have no vegetarian feeders among the fishes yet subjected to cultivation in America, or among those that are of sufficient importance to call for cultivation in the future, except possibly as furnishing food for more valuable species. All the salmon and trout and whitefish the grayling and smelts, the perch, the bass, &c., must be regarded as strictly animal feeders.

Mr. Susta's classification is liable to this criticism, that though it may apply correctly to the adult stages of all the fishes mentioned, it does not recognize the fact that when very young, all the predatory fishes must perforce take their food in very small mouthfuls, and are therefore in their early stages to be classed with carp and tench and the coregonoids as subsisting on minute animal life. Now the great problem of fish-feeding with us is, at present, and perhaps will always continue to be, how properly to nourish the fish through their early stages; so, whether we are rearing carp or trout or salmon, the question of providing minute animals for their sustenance is one of paramount interest.

While Susta was studying the digestion of his carp, another fishculturist, Thomas Dubisch, the manager of a large pond-interest in Austrian Silesia, was perfecting and reducing to practice a system of management for carp-ponds, of his invention, which has attracted great attention, and is likely to be generally adopted by carp-breeders; and from which we can safely draw lessons for our guidance in the culture of salmonidae in ponds.

The Dubisch method, or that portion of it with which we have to do, consists essentially in having a soft and rich bottom to the pond, and drawing off the water so that the pond shall be completely empty and dry as long as possible each year, including the winter. If a

pond is emptied of fish in the autumn it is immediately laid dry and allowed to remain so until just before putting fish into it again the next spring or summer. The purpose of the soft and rich bottom is to encourage the growth of animal life. The laying dry is useful in two ways: first, it destroys predatory insects and other vermin which, in a pond continually filled with water, become so abundant as to prove very destructive to fish-food and to the young fish themselves; second, through the drying and freezing it appears to directly encourage the development of the eggs of the small crustacea which form the most important part of the food of young fish. The water-level must be reduced to at least a foot below the bottom of the pond, else the vermin may not be destroyed.

Here we have reached what may perhaps be considered the most important point in the whole live-food business, the encouragement of the food and the destruction of the vermin by the simple process of laying the pond dry. The life-economy of the small crustacea, the entomostraca, is adapted to just these conditions, water for a portion of the year, drouth and frost for the rest. It can hardly have escaped the attention of any one interested in these matters what multitudes of minute creatures people the pools that are filled with water in the spring and dry up in the summer and autumn. It is nature's way, and in devising his system Dubisch has simply been following nature.

The most important members of this pool fauna are the entomostraca, the daphnids, copepods, ostracods, and their relatives. They owe their importance to their ability to endure drying and freezing as mentioned above and also to the enormous rapidity of their reproduction. A *Daphnia*, for instance, is endowed with the faculty of producing, under proper environment, such as obtains in the spring, generation after generation of

young without the intervention of the male ; these young are all females and all likewise capable of reproducing without the male. The mother gives birth to living young every three or four days, say an average of 15 to a litter. In a week or ten days these young are mature and begin in their turn to reproduce. Thus in the course of 60 days, according to one calculator, the descendants of a single Daphnia may number more than twelve hundred millions. Such enormous fecundity is not found, I think, among any other creatures that are of suitable size to serve as food for fish. The other entomostraca are also very prolific.

Given plenty of entomostraca, the first condition of growth of young fish is met. But the multiplication and growth of the entomostraca is only possible when they too have an abundance of food, and they also are animal feeders. So another group of animals still more minute must precede the entomostraca. These are found among the protozoa, whose food is decaying vegetable and animal matter, such as is found to a certain extent in ordinary rich earth, and much more abundantly in animal excrement and the debris of succulent plants. Thus the basis of the system is a pond-bottom rich in animal and vegetable matter in process of decay. This nourishes abundance of protozoa ; the protozoa nourish the crustacea ; the crustacea nourish the fishes.

The question naturally suggests itself how far we may expect a system devised for carp and found applicable to their culture to meet the demands of trout and salmon culture. Truly only in a very general way, until experiment determines the details of its application. I am not in possession of any authentic evidence that salmonidae have been reared in ponds managed after the Dubisch or any similar method. Yet there seems no good reason to doubt that it is quite feasible so to grow them. Trout have been grown very suc-

cessfully in ponds on natural food. At the meeting of this society in 1892 [see report, page 64]. Mr. N. K. Fairbank of Illinois, described his method of growing trout in an artificial pond fed with spring water, wholly on the food produced therein, without any care further than to put into the pond quantities of a weed on which he had found a good many shrimps, put in the fry and let them alone. In this way he estimates that fifty per cent. of the fry live to be yearlings. This he has done year after year.

In a paper read at the meeting in 1892 Mr. Page gave several instances of parties growing trout successfully on live food. One of the parties referred to was Mr. Thomas Andrews of Guilford, England, who rears trout on a very large scale in ponds supplied with spring water, of a temperature ranging from 49 in winter to 56 in summer, making very considerable use of live food, especially shrimps (*Gammarus*) and snails (*Limnaea*) which are grown in separate ponds and transferred to the fish-ponds to be eaten, and in some cases allowing trout to forage for themselves, without any artificial help, but depending mainly on chopped horse-flesh. From some more recent writings of Mr. Andrews and some other sources, I learn that he has made no attempt to imitate the methods of the continental pond-culturists, has little faith in their theories, and considers *Gammarus* and *Limnaea* superior to *Daphnia* and other entomostraca as food for trout. In some of the water-leads between his ponds, he is able to take at one time, with little trouble, "many solid gallons" of small animals, mainly *Gammarus* and *Limnaea*, yet this abundance of life appears to be an accident of the conditions existing and not a part of the scheme of management.

It is well known that carp are most advantageously bred in shallow ponds in which the water becomes very warm under the influence of the sun, and the difficulty

suggests itself that ponds in which the crustacea can be produced by the Dubisch method may be too warm for the trout or salmon, and that on the other hand if we keep the temperature down to the point required by the health of the fish, it may be impossible to rear their food. Dr. Kochs of Bonn, has advised that this difficulty be avoided by growing the crustacea in shallow ditches connected with the cool pond or brook in which the fish live, and into which the crustacea will be washed by the currents created by the rise and fall of the water. This idea has been elaborated by Mr. Karl Wozelka of Prague, in a little book recently published, entitled "New Methods of Fish-breeding combined with Willow culture," in which he presents several plans, worked out in minute detail, of systems of breeding ditches and basins connected with ponds and with brooks, claimed to be drawn from his own experience. Some such system would probably prove practicable.

It is quite possible that the identical species of crustacea grown in the carp ponds might not thrive in water cool enough for trout, but there are others that surely would. Many copepods are found in early spring in very cool pools, sometimes at Craig Brook even anticipating the disappearance of the ice, and several species of daphnids occur in active condition in the depth of winter. The careful observations on the occurrence of aquatic animal life during each day of the year ending Oct. 31, 1893, at the biological station at the lake of Plön in the northern part of Germany, disclosed the presence, in abundance, of several species of entomostraca during every month of the year. From January to April, inclusive, there was the greatest scarcity, yet no less than seven species of entomostraca were abundant in mid-January, and with the exception of the period from March 20 to April 10, there was no part of the entire year when some species was not found in abundance.

I had some years ago an opportunity to note, at Bucksport, Maine, a phenomenon of like character with those recorded at Plön. In the Fall of 1872 I built a dam across a brook in Bucksport, to obtain a head of water to use in a hatchery. The ground was part of an old pasture, and cows waded freely about in the brook, and for a time, in the small pond formed by the completion of the dam. A portion of the ground flowed was a small alder swamp. Late the following winter there came down into the hatchery great numbers of living entomostraca, mainly Daphnids. We practiced at that time the filtering of the water through a flannel screen set across the head of each trough, and so great was the number of the entomostraca that they often completely clogged up the screens, causing the water to overflow. This continued for several weeks. The pond was all the winter covered with ice, and the mean temperature of the water was as follows: in November, 39.1 F.; in December, 35.17; in January, 34.5. Whether these entomostraca subsisted on their normal food, protozoa, or not, it is evident that they found sufficient nourishment even in that very cold water, and we are warranted in drawing the conclusion that daphnids may not only be bred in water cool enough for salmon and trout, but that they may probably be brought out at any season of the year by proper management.

The elaboration of methods of managing fish-ponds for the production of live food appears to me, therefore, to be the most important task to which fishculturists can in these days address themselves. It may require a great deal of experimentation and study, and perhaps much patient waiting, but I cannot doubt that a satisfactory system of management will finally be evolved, the introduction of which will constitute an advance in fishculture as important as the introduction of artificial impregnation and incubation.

ALASKA'S FOOD FISHES AND THE INTERESTS OF ITS FISHERIES.

BY DR. BUSHROD W. JAMES, PHILADELPHIA.

MEMBER OF PENNSYLVANIA FISH PROTECTION ASSOCIATION.

Probably I should give as my reason for so often writing upon the natural resources of Alaska, that having visited the country and become a member of its historical society, I consider myself in a measure identified with its admirers and defenders. The seal industry alone has given the Territory importance for so many years, that the recent disturbance, judging only from that standpoint, appears to have demoralized it to such an extent that its future might be considered as almost hopeless, so far as its value to the United States is concerned; but the seals actually represent but a small percentage of its great resources, among which gold, silver and coal have prominent positions. Yet I have no doubt that more extensive investigation will demonstrate that seals, gold, silver and coal are surpassed in value by the immense quantities of excellent food fishes which attain to great size and perfection in the peculiarly pure waters of Alaska.

Dr. Tarleton H. Bean, whose position as a member of the United States Fish Commission has led him to minutely examine into the numerous kinds of food fishes in Alaska, and their approximate value, has returned such an extended and accurate report of his investigation to the government, that I may be considered rather bold in touching upon the subject. As my defense, I will mention that Dr. Bean's report is so identical with

the statistical business of the United States Fish Commission that it has not obtained the wide-spread publication which would have placed it before the great community of readers who are interested in such matters.

Much of my knowledge upon the food fishes I have gained through consulting those reports as well as the various books published by travelers in Alaska. To this I have added by my tour in that country and still more probably by taking a merely common-sense view of the whole subject. We are well aware that fish must always be, as it ever has been, a staple article of diet with islanders and coast dwellers. Year after year its popularity has spread inland, until fine smoked, salted and canned fishes are welcome to nearly everyone's table. The marked improvement in the preparation and preservation of fish has made the demand greater from season to season, and refined tastes have created a desire for the best and most delicately flavored of the various kinds. To supply the greatly augmented requirement, the large Eastern fisheries have in some places been depleted, while in others the stock has deteriorated through too continuous catches. Looking Westward, we can see plainly wonderful quantities of the same kind of fishes ready to replenish the failing stores and to take the place of the Eastern supply, at least until time is allowed for their renewal in growth and numbers. Perhaps we may not obtain the truly fresh fish as it lands in the California markets, imbedded in pure, translucent ice, but cod, halibut, herring and mackerel for drying, salting or smoking, and salmon for canning are more than abundant and proportionately fine in size and quality.

The several kinds of salmon were the subject of the paper offered by me for the consideration of this association two years ago; therefore I need not touch

upon them at this time except in the brief table of statistics which is appended to the present article.

The halibut of Alaska grows to a great size, sometimes weighing three hundred pounds and even more. It is a very important fish to the natives, who devote themselves to its capture almost exclusively. Smoked halibut is very excellent in flavor and must some day win its way into our markets, though as yet only a few thousand cases are prepared for commerce.

Cod of Alaskan waters is almost analogous with the fish of the eastern coast whose fame is wide-spread, except that it grows larger and by dealers in the Western States it is considered superior in both fibre and flavor. Another point in its favor is that as far east as Chicago, it is cheaper as well as better than its compeer of the Atlantic. The value of Pacific cod may be roughly estimated by the returns for its receipt in San Francisco in 1893, when there were 1,243,000 fishes delivered to the numerous dealers. Even at variable prices the income must be large, for the fishes sometimes when caught reach a weight of thirty pounds each. The receipts of these fish alone at San Francisco have amounted to 29,123,800 fishes between the years 1865 and 1893.

Even estimating the individual weight to be small the returns seem to prove that the Cod Fisheries alone are well worthy of protection. Cods abound in the sea and ocean around the Aleutian Islands, and are so plentiful that they can be obtained at almost any time in the year. Taking the statement of dealers in Chicago and other central Western cities regarding quality and price it is reasonable to believe that a systematised arrangement could be made which would benefit commerce in the States and aid the islanders in gaining a less variable livelihood; for the poorer part of the population on the islands and near coast are practically compelled to fairly gorge themselves during the season

when seals, whales or walruses can be obtained, and live a life of semi-starvation the remainder of the year.

Alaskan herring is positively so super-abundant during the running season that millions are thrown upon the beach by the tides, where they remain to perish, a most reprehensible practice there or elsewhere. Perhaps the possibilities of this fish cannot be highly estimated because of the lack of fuel to use in smoking, the only manner in which this species seems to be considered palatable. But there may yet be a way found by some enterprising American to utilize this enormous production of the sea. From the great waves which leap far on to the shore in stormy weather, thousands of tons of kelp, a strong, ropy sea-weed, are thrown and left beyond the reach of their recession. The natives use this for fuel but leave vast quantities to waste. Perhaps the time will come when this material will be used in preparing the fish for Eastern markets. Used for food when fresh, it is claimed to have superior qualities to those of the herring of the Atlantic coast.

Mackerel, that prime favorite of salted fish, abounds in quantities almost beyond belief. The vast schools appear near the coasts at Attu literally piled one upon another. They grow to fine size, and the flavor is said to be the same as that of Atlantic mackerel. Their season is short—from June 1st. to July 31st—but Mr Lucian Turner asserts that from his own observation “500 barrels of 200 pounds each could easily be prepared at the rate of about \$2.00 per barrel.” It would be a slight matter to erect fish-curing sheds (men work willingly for a \$1.00 and women for 50 or 75 cents per day) and as the Alaskans are experts in cleaning the fish, doubtless Mr. Turner’s estimate could be over-reached by systematic labor. The value of these few species of fish alone would pay for investment in the addition to the stock for trade, and go a great distance in teaching the natives to utilize the abundant products

of the sea in obtaining other comforts for themselves through the profits of their work.

The size to which fish attain in Alaska appears almost incredible. White fish of from thirty-five to forty pounds in weight are common in the waters from St. Michael's to Anvik. During the season they are eagerly sought for by the natives. Black fish grow very large and are wonderfully abundant. Dr. Bean and Mr. Turner state that they run for "many miles along the coast, and into the rivers where they are the chief dependence for about three thousand inhabitants with their dogs. In three months sixty-nine tons are taken. The average is about 103.5 tons in a season." These as well as Tom Cod and Lamprey Eels are frozen in grass bags or possibly left upon the ice to be chopped in pieces when wanted. Sometimes the mass is sliced and eaten raw, and often it is boiled, but in either case the natives often have only this form of food, when other food supplies are unattainable. By a grateful adaptability to circumstances neither men nor dogs seem to desire anything better.

The fishes which I have here mentioned are but a few of the most valuable of the many excellent species which are plentiful beyond computation. There are flounders, greylings, smelts, sticklebacks, eels, sturgeon, sculpins, and in fact nearly all kinds of fishes from whales to minnows, and all enormously abundant. By this we can plainly see the peculiar provision which nature has made for both the human and animal inhabitants of that strange north country. The people are poor in every comfort outside of that to be obtained from the creatures of the ocean or its near neighborhood. Confined to a country in which land animal food is but scarcely distributed, and vegetables, fruit and milk are unknown, the human inhabitants have been necessitated to subsist upon that which could be found in sufficient quantity. Salt being an almost unknown commodity

until the advent of the Russians, they have been contented in earlier days to eat from year's end to year's end, unsalted fish, whale, seal and walrus, a diet that would be utterly abhorrent to anyone but themselves. They have found in these mammals all the requirements for food and clothing, fire and light, and in their absence fish and a few roots and berries have been their only luxuries. The love of home is innately strong, so the manner in which to make them more comfortable and nearer to equality with the other inhabitants of the United States is to teach them to utilize for trade all the food fishes possible.

Naturally those who live in the more remote localities will be sometime in their pristine condition and the great duty devolving upon those who are in power is to protect their main-stay in the sea and its tributaries. The smaller fishes are the food of the larger, such as cod, halibut, salmon, herring and mackerel; these again are the prey of the still larger, and the very existence of one depends upon the safety of the other. The profits in whale fishing have fallen off considerably because of the manner of slaying and the greed of those who are not careful in selecting their animals. Explosives particularly, not only destroy the monsters who are sought for oil and bone, but they injure the more abundant smaller fishes.

Direct from a San Francisco whaler comes the news that his vessel made its usual voyage, which occupied nine months, when it was compelled to return for provisions with but one medium sized whale for the season's returns. This individual blamed the disastrous season on the illicit fishing, and the use of fire-arms and powder, which frighten the timid creatures away from their haunts. The loss to the whaler is serious, but the natives who depend upon the cetaceans for their living in certain parts of the year, must suffer pitifully by their absence.

A strangely consistent array of benefits will arise in the proper protection of the seals in the Behring Sea because the interest in that will redound to the good of all. If fishing vessels desist from unseasonable hunting, whales and walruses will most probably return in numbers to their old haunts.

The protection of food fishes will commensurately preserve the food of the greater animals, and smaller fishes will multiply in numbers sufficient to supply food for those of greater value. A law requiring fishes of no marketable value to be returned to the sea immediately, will prevent great loss in the food supply of important mammals and large fishes, and prevent some of the most unpleasant hindrances to those who are unwilling to engage in the business because of the odor of decaying fish. Doubtless, the offal from canneries and salting and drying stations could be utilized for fertilizers with but little trouble.

If the location renders it impossible to reduce the pulp to anything of value, it surely could be returned to the water and become the food of other fishes or crustaceans. The plausibility of civilized and comparatively delicately reared white men engaging in the laborious part of catching and cleaning food fishes for market is very doubtful, but the natives seem willing to work for wages, and if they are taught the mode of preserving to suit the market both East and West, there will be no great need for white men to engage in the manual labor.

Doubtless, Aleuts could be taught to become trusty superintendents as well as workmen, and companies need but employ a few others to oversee, and attend to packing and shipping. There is no possible mistake in asserting that with proper management there is a mine of wealth in the fisheries of Alaska. The Eastern coast has not within the knowledge of history ever been the vast, almost illimitable store-house of food fishes

which Behring Sea, the North Pacific and their numerous tributaries are to day. The United States in general needs this grand supply to add to its commercial value, and the Treasury can make profitable use of the revenue which will result. And a question which is of vital moment is the great good that must accrue to the people of the country. They need to be brought nearer to the standard of the rest of the nation. To bring them into closer touch with the sister states and territories, no plan could be adopted more certain and consistent with all the laws of right than to teach them to use for themselves the best means of utilizing that with which nature has supplied them in super abundant measure.

In order to give an idea of the value of a few of the fisheries of Alaska, I beg leave to append the following statistics whose authority is unquestionable, having been calculated from the accounts of Dr. Tarleton H. Bean, Mr. Lucian Turner, Mr. E. W. Nelson and Mr. Frederick True, and also from the "Alaskan" a bright little paper published at Sitka, the capital of Alaska.

For the year 1893 the returns of salmon at San Francisco were 693,262 cases of canned fish (with one district not reported) and 32,102 barrels of salted fish.

Estimating the value at \$4.00 per case it would reach \$2,773,048 for the canned salmon. The salted at previous estimate, \$9.00 per barrel, would amount to \$288,918.

The receipts of Pacific cod in 1893 were 1,243,000 fishes, while the returns from 1865 to 1893 reached the enormous aggregate of 29,123,800 fishes. The value in 1889 was \$50.00 per ton, which would make the total valuation for those years at least \$205,725.

Summing the value of the salmon for the year 1893 alone, and that of the cod mentioned above, we would have a total from those two only partially developed industries of the Territory amounting to the round sum

of \$3,267,691, or nearly one half of the purchase money of our northwest possessions.

The total amount of canned salmon in Alaska from 1878 to 1890 was valued at \$9,008,497; the salted from 1881 to 1890 yielded \$603,548. The full receipt for cod from 1868 to 1890 equalled \$1,246,650; and the products from the whales were valued at \$11,057,418. Allow me to conjoin the value of these three fisheries alone and we have the grand total of \$21,916,113, more than three times the purchase money. This has no connection with the profit from any other industry whatever and tells for itself whether the object of the United States Fish Commission and Fish Protective Associations are not both laudable and necessary adjuncts to the advancement of the great commercial interests of our country as well as to the aggrandisement of its people and the developement of its northwestern resources.

For comparison permit me to add the value of the Furs, mostly

Sealskins,	- - -	\$48,518,929.
Gold and Silver,	- - -	4,631,840.
Ivory, from Walruses genl'y		147,047.
		\$53,297,816.

being the aggregate from 1868 to 1890.

Thanking my colleagues for their earnest attention and their patience with my rather dry details, I retire with the hope that the Fishing Interests of Alaska have not suffered from my earnest desire for their protection and advancement.

**COMPARATIVE SUMMARY OF THE FISHERIES OF THE
UNITED STATES IN 1880 AND 1892.**

States.	Persons employed.		Capital invested.		Value of products.	
	1880.	1892.*	1880.	1892.	1880.	1892.
New England:						
Maine.....	11,071	15,128	\$ 3,375,994	\$ 2,882,113	\$ 2,742,571	\$ 2,225,806
New Hampshire.....	414	373	209,465	93,328	176,684	91,481
Massachusetts.....	20,117	17,025	14,334,450	12,080,679	7,959,760	7,531,104
Rhode Island.....	2,310	1,584	506,678	1,034,467	666,814	725,675
Connecticut.....	3,131	2,015	1,421,020	2,868,921	933,242	1,871,413
Total.....	37,043	37,025	19,937,607	19,859,908	12,509,071	12,445,569
Middle Atlantic:						
New York.....	6,465	12,246	2,573,535	5,202,970	3,763,537	4,784,753
New Jersey.....	6,220	10,433	1,493,202	2,517,764	3,103,927	3,625,890
Pennsylvania.....	452	2,220	94,811	97,011	276,600	284,031
Delaware.....	1,979	2,247	268,231	218,120	997,695	250,865
Maryland.....	26,008	39,944	6,344,443	7,465,718	5,221,715	6,460,750
Virginia.....	18,864	23,595	1,914,119	2,944,559	2,997,043	3,641,282
Total.....	59,989	90,485	12,485,331	19,405,151	16,360,517	19,047,580
South Atlantic:						
North Carolina.....	5,274	10,274	506,561	1,243,988	845,695	1,027,669
South Carolina.....	1,005	2,701	66,275	127,762	212,482	202,602
Georgia.....	899	1,622	78,770	174,431	119,993	123,563
Florida.....	368	1,541	43,554	146,895	78,408	236,060
Total.....	7,546	16,138	695,160	1,693,076	1,256,578	1,580,804
Gulf:						
Florida.....	2,112	4,335	362,563	1,377,057	564,819	1,103,800
Alabama.....	635	618	38,200	135,290	119,275	154,871
Mississippi.....	186	1,721	8,800	434,710	22,540	245,699
Louisiana.....	1,597	4,068	93,021	719,876	392,610	681,284
Texas.....	601	1,277	42,400	319,122	182,300	313,832
Total.....	5,131	12,019	545,584	2,093,084	1,227,544	2,499,495
Pacific:						
California.....	3,094	5,426	1,130,675	2,156,662	1,860,714	3,044,731
Oregon.....	4,483	4,200	687,000	2,220,667	605,302	868,406
Washington.....	3,096	4,296	474,708	1,590,481	417,932	934,940
Alaska.....	6,130	2,849	447,000	2,535,703	2,661,640	2,410,348
Total.....	16,803	16,771	2,748,383	8,873,813	5,545,588	7,258,925
Great Lakes:						
New York.....	922	7,498	59,050	697,847	154,870	256,596
Pennsylvania.....	114	403	24,700	283,238	43,450	211,122
Ohio.....	1,046	2,738	473,800	1,874,900	518,420	618,683
Michigan.....	1,781	3,343	442,065	1,458,884	716,170	934,005
Indiana.....	52	94	29,360	21,549	32,740	21,093
Illinois.....	300	386	83,400	429,545	66,100	23,836
Wisconsin.....	800	1,225	223,640	401,374	253,100	399,272
Minnesota.....	35	51	10,160	170,743	51,200	6,238
Total.....	5,050	9,738	1,345,975	5,478,080	1,784,050	2,471,355
Grand total...	131,426	182,376	37,958,040	58,245,406	38,683,348	45,312,818

* This year is placed at the head of the columns for the reason that it is the most recent one to which the statistics relate, and the one to which most of the figures apply. The data for the New England, Middle Atlantic and Pacific States are for that year; those for the South Atlantic States, the Gulf region and Great Lakes are for 1890.

IMPROVED METHOD OF HATCHING SMELETS.

BY FRED. MATHER.

Outside of my own articles on smelt hatching in the fourteenth, fifteenth and sixteenth Reports of this Society, I can find nothing on the subject except an item in the paper of the late Prof. H. J. Rice on "Salt as an Agent for the Destruction of the Fish Fungus" in the thirteenth Report. On page 19 Professor Rice records that in 1877 he was studying the embryology of the smelt and found the eggs in masses in the hatching jars and covered with fungus, but not until 1884 did he have a chance to try the effect of salt on killing this *Saprolegnia*. The eggs were upon blades of sedge, or water grass, after the manner employed by Mr. Charles G. Atkins some years before, which "prevents to a great extent, if not entirely, the massing together of the eggs, since the rough surface of the blades allow only a single layer, at most, to adhere to the surface." Still there was much fungus present. The salt killed the fungus and "only about five per cent. of the whole number failed to hatch." This is a much better percentage than I can show to-day, and I do not know of any other fishculturist who has hatched this fish within the past five years. Professor Rice did not do the hatching but merely studied the development of the embryos and took the statements of others regarding the percentage; and the latter need salt, also.

In the fourteenth report of this Society, for 1885, pages 17 to 32, will be found my first paper on this subject, with discussions following it by Hon. Theodore Lyman and Prof. Rice. My paper was entitled

"Protecting and Hatching the Smelt," in which I advocated a protective law, which is now being asked for from the supervisors of Long Island towns. Skipping this part of the subject, we will take up that which relates to the hatching of smelts, omitting many details related in that article, and will quote: "Up to the thirteenth day after taking there was little change, and on the twentieth (of March, or seven days later) the eggs were put outside the hatchery in swift water, as they began to show fungus. March 26 about one-half were alive, and these were in bunches covered by dead eggs and fungus. All the outside eggs were dead and I had little hope of saving any." That year we allowed the eggs to adhere to grass, sticks and stones, as well as to the sides of glass hatching jars, and in that Report of 1885 I expressed the belief that smelt eggs seemed to require a coating of fungus and decayed eggs about them in order to be protected from too much oxygen and fresh water to hatch well, a statement that I do not believe to-day. We turned out 100,000 fry that year in spite of fungus, rotten eggs and accompanying foul odors in the water.

Again, in the fifteenth Report of our Society, pages 10 to 16, will be found another article of mine, headed "Smelt Hatching," with discussions by Mr. Frank N. Clark, Mr. Bissell, Dr. R. O. Sweeny and myself. My paper merely recorded efforts to have the spawn adhere to different substances and to vary the flow of water and the amount of light. Some eggs were sent to Mr. Clark, cautioning him not to throw away any eggs, "no matter how badly they looked on the outside, how much fungus there might be there, nor how foul an odor might arise from them." Mr. Clark said, page 13, that he found the eggs as I had stated, and about 15 to 20 per cent. of them were good. I had said that we could hatch 40 to 50 per cent. in our jars. Mr. Bissell raised the question of light, and said: "If the light affects the

eggs of the smelt, would not the light affect them in their natural condition in a small stream?" To-day I can only answer this very sensible question by saying that sunlight will kill our eggs in the jars, and in this year of our Lord, 1894, I have seen smelt eggs hatch on stones in a rapid stream with not over two inches of water over them, and in the brightest of sunshine. This is one of the problems that we have not solved.

In the Report of our Society for 1887, page 11, will be found my item on smelt hatching under the title of "Work at Cold Spring Harbor." In this it is stated that "out of 4,000,000 eggs we hatched and planted 2,000,000 fry, or about 50 per cent., which is as good as we have ever done." I added that "the little smelt carries a great many eggs for its size, from 30,000 to 60,000 or perhaps more, and from 100 ripe females of good size, probably 5,000,000 could be obtained." In the reports of the U. S. and N. Y. Fishery Commissions the foregoing statements have been embodied, the American Fisheries Society getting the first reports because their meetings were held earlier in the season than the other reports were called for.

Until last year we stripped the fish and impregnated the eggs by hand, but holding our fish in the hatching troughs until ripe we found that many females had spawned in the troughs and also that the percentage of impregnation was very high and that they hatched well. This year we gathered all our eggs from the troughs, passed them through wire screens to separate them and put them in the jars. At intervals of two or three days or whenever the eggs seemed inclined to gather in bunches we repeated the operation, gently forcing the eggs through the screens with the fingers, and after a few such screenings the "foot" seemed to be destroyed. This "foot" is a projection on the egg, which is shaped like the stem and bottom of a wine glass, and is the only point of adhesion which the egg of the smelt has;

there is no glutinous coating around the egg of the smelt that will enable it to adhere at any point, and the frequent breaking of the hold of this foot makes it powerless to adhere to other eggs or to any object, and leaves the eggs as free and clean as those of whitefish or shad, and enables the attendant to remove all bad eggs from the top, as is done with other eggs hatched in jars.

Last year I was greatly interested in the paper read by Prof. Jacob Reighard of the University of Michigan, "On the Handling of Adhesive Eggs," and of his use of corn starch to overcome the adhesive tendency in the eggs of pike-perch, and had thought of testing that method with smelt eggs, but they worked so well with a few siftings, that it did not seem necessary to try any other method. The eggs remained free and clean, with the exception of those in one jar, which were taken from the brook, that retained sand on some of them that would not permit the dead ones to rise.

A resume of my work in stocking a barren stream with smelts for the New York Fishery Commission will illustrate the value of such work in a manner that can only be shown when fry of any fish are placed in waters which did not contain them before. Adjoining the grounds of the Commission at Cold Spring Harbor, Long Island, is a short stream from the overflow of a mill pond. This stream is not over 600 feet long between the dam and salt water, at high tide, and is about 15 feet wide, with pools and shallows where the water ripples over pebbles and is not 2 inches deep. This stream I stocked with smelts in a small way in 1885, and it is now a fine smelt stream.

In that year, and for several years afterward, we bought live smelts from the Connetquot River,* a small stream rising in the center of Long Island, north of

*In the reports the printers have usually made this the Connecticut River, and this note is to warn them that the above spelling is correct.

Yaphank, and flowing into Great South Bay near Bellport. We paid ten cents each for the fish and would get two or three hundred smelts of different sizes and degrees of ripeness.

In 1890 we only bought 100 fish, as we had an offer of all we wanted without cost from Mr. H. Scudder, of Northport, only seven miles distant. Next year, or six years after the first small planting, we found that the smelts were running up our stream in numbers to make it worth while to try to get eggs from it, and we did.

This was the first proof that the little brook had been made a self-sustaining smelt stream, although we knew that a few fish had run up it in years before. The habit of the smelt to run up streams at night, and return to salt water before day, enables it to escape observation to a very great extent unless one is especially on the watch for its coming. The eggs are deposited on stones in the swift water, and never in the pools, where the flow is slower. They are hatched in bright sunshine, which will kill our eggs in the jars, and unless it may be a provision of nature to check the increase of this prolific fish by killing the eggs that chance to get the direct rays of the sun, and to have only those which lie on the shady side of stones come to life, I cannot understand why the sunlight is fatal in the jars. Perhaps we may solve this problem some day, but an inspection of the stones in the stream, where millions of eggs were laid this year, did not offer a solution to this question which, by the way, never came up until the hatching season was about half over. Next year we may observe the effect of the sun on the eggs in the stream more carefully; we know what it is in the jars.

Our plantings in this little stream were:

1885	- - -	100,000 fry.
1886	- - -	2,100,000 fry.
1887	- - -	2,000,000 fry.

*1888	- - -	1,000,000	fry.
1889	- - -	4,600,000	fry.
1890	- - -	3,950,000	fry.
		500,000	eggs sent away.
1891	- - -	7,400,000	fry.
1892	- - -	5,631,000	fry, and eggs sent away.
1893	- - -	5,722,000	fry.
1894	- - -	22,603,000	fry.

Total planted 55,606,000 eggs and fry.

Until this year there was no demand for the fry, because it was not understood that the Commission could furnish smelts; but the demand increased with the supply, and outside of the 11,083,000 planted in Cold Spring Harbor there were two plants on the South Side, three in the tributaries of Peconic Bay, one in Westchester county, and seven plants at different points on Long Island Sound. These plants were all made on special applications to the Commissioners of Fisheries, and it pleased them to have them made, because it showed appreciation of their work in a field that was almost new.

The value of the smelt may be illustrated when we know that forty carloads were shipped to New York from New Brunswick this year, besides the supply from Maine, Rhode Island and other places. Long Island smelts do not now make a great figure in the market reports, but the plants of this year, which were of one million fry, in most cases, may work a change to the benefit of the fisherman and the consumer in a few years.

Our figures this year were :

Eggs taken	- - - - -	31,708,000
Loss of eggs†	- - - - -	9,105,000

Fry planted	- - - - -	22,603,000
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*The March blizzard this year, from 12th to 20th, prevented getting eggs.

†This loss includes two million eggs lost by the clogging of a tube supplying two jars on the night of March 17.

The figures show that over 71 per cent. of the eggs taken produced fry, and the reports of a few years ago show that when we produced 50 per cent., and thought it good, Mr. Clark remarked that it was as good as might be done with adhesive eggs.

That we have made rapid strides in the work of smelt hatching is shown by the table giving our yearly plantings, where it will be found that of the 55,000,000 fry and eggs distributed in ten years almost half the number was sent out this spring. It should also be borne in mind that this great result was obtained from an insignificant stream that never contained smelts before—it was stocked by the New York State Fishery Commission.

COLD SPRING HARBOR, N. Y., May 10.

ADDRESS OF CAPT. COLLINS.

Mr. Chairman, Mr. Chamberlayne has alluded to my name in his paper, and I feel that I should make some comment upon it, especially as I represent the Commercial Fisheries Association. If the fishery interests, or industries, could do all that Mr. Chamberlayne has stated, they would be given a much better showing than they now have.

As a matter of fact, the commercial fishermen of this country always have had all they could do to maintain themselves and to earn a living. As a rule, fishermen are poor men, and always have been in every age and in every country. For this reason not only has it been the object of this country to foster sea fisheries in other days, but other nations have done likewise.

As opposed to what Mr. Chamberlayne has said, permit me to state that the so-called fish protective associations of this country largely represent the money, brains and influence of this great land. Look around you and see! Here are men of wealth; men who represent the press; men whose moneyed interests count ten to one against what the fishermen have.

If the fishermen have organized for the purpose of gathering data concerning the fisheries—a fact which no one will deny—who can find fault with it? If we are to judge correctly of these matters, we must have a basis of fact to rest conclusions upon.

I deny that it has been in the power of the fishermen to do what it is claimed they have done. Such papers as these are wrong. They do great injustice to industries which help this country.

I ask any man here if these fisheries have been conducted illegally. Mr. Chamberlayne has said that

the fishermen find it easier to secure the enactment of laws favorable to fishing than it is to meet harsh measures in court, and be compelled to defend themselves against unwise laws which have been made. Of course they do, if that is possible, and so would anyone.

Now, underlying all this question is the claim that sea fish are growing scarce. I have had an experience in sea fisheries going back to 1849. I know something of them from actual observation, and am prepared to say that there have been fluctuations in the abundance of many species of our fishes since the beginning of the history of this country. This cannot be controverted. Take the mackerel, for instance. In 1671—more than 220 years ago—the General Court of Massachusetts passed a law restricting the mackerel fishery, because it was felt there was danger of extermination of the species. You can put your own estimate on this. But it is well known that the entire catch of New England at that time did not amount to so much as one vessel might take now in a single prosperous season. Since the beginning of the mackerel fishery, as an important commercial industry in the early part of this century, there have been as great fluctuations of abundance as have ever been known to occur in the history of this fish. In 1831 the ocean off the New England coast was filled with mackerel, and the catch was very great. At that time fishing for mackerel was carried on almost exclusively with hook and line. A few drag seines and gill nets were used along the coast, but the catch in these was unimportant. There were no purse-seines then in use for catching mackerel. Nevertheless, mackerel began to decline in abundance immediately after this great yield, and in 1841 the catch amounted to only a little more than 50,000 barrels as against about 400,000 barrels ten years previously. They reached low water in abundance in 1841. Then the

scale began to rise, though somewhat irregularly ; and about 1850 mackerel were plenty again.

Now, let me say right here, that the introduction of the purse-seine in the mackerel fishery began in 1839, and about 1860 it was pretty generally used. But in 1884, forty-five years after the adoption of the purse-seine as an implement for the capture of mackerel, and a quarter of a century after it was almost universally used by mackerel fishermen, mackerel were as abundant off the coast of New England as they have ever been at any time since the settlement of the country. Who will believe that the purse-seine is instrumental in causing a decrease of the abundance of this fish when it had no such influence during the twenty-five years ending in 1884.

Now, immediately after this great plentifulness in 1884, history began to repeat itself. There was a decline the next year in the capture of mackerel. The yield of salt mackerel in New England for 1890, according to the report of the Boston Fish Bureau, was between nineteen and twenty thousand barrels. Then it reached its low water mark again. And one reason that the mark was so low is ascribable to the small number of vessels engaged in the fishery as compared with 1841, when a large majority of the fishing fleet of New England was thus employed. Well, sir, starting from that low point there has been a gradual upward tendency in the yield of the mackerel fishery, and last year the New England catch of salt mackerel, according to the authority I have quoted, exceeded 55,000 barrels, notwithstanding a less number of vessels was employed than in 1889, when the catch was not quite two-fifths as great. The catch last year was almost three times as much as it was in 1890. I do not know what success this year may bring. I am not a prophet, nor the son of a prophet, but think one would not risk his reputation very much if he took upon himself the responsibility of

predicting that within the next decade there will be as great an abundance of mackerel as we have ever seen. If so, it will be another repetition of history, for all of you are familiar with the fluctuations of the mackerel fishery.

Now permit me to speak of a few other species. Facts are stubborn things to deal with, but they cannot be ignored. Fulton market stands in evidence this spring to show that bluefish were never more abundant within the memory of man than they now are. The vessels that have come into Fulton slip this spring were loaded to their scuppers with bluefish. The market has been so over-stocked that there has been scarcely any sale for them. The bluefish is one of the best food species in the world, and it has been selling at about one and one and a-half cents per pound. These fish were taken with hook and line. It is assumed that nothing will be said against that method of fishing.

In a hearing before a joint committee of the New Jersey Legislature a few weeks ago, the gentlemen who represented some of the real estate interests on the coast, while conceding that bluefish were abundant at sea a few miles from the shore, complained because they did not come in nearer to the land. How can that be rectified? Will anybody suggest how it is possible to influence bluefish to move out of the route they have chosen for themselves?

The Commissioner of Fisheries of the United States, in presenting his paper yesterday, made some statements relating to the decrease and increase of various species of food fish. These statements showed that the catch of bluefish in 1892 as compared with 1880 indicated an increase of 1,250,128 pounds. I concede that these figures are estimates to a considerable degree, so far as 1892 is concerned—as are the figures showing a decrease in the catch of certain species of fish—for the reason that there has been no investigation of the fisheries of

the Gulf States and South Atlantic coast since statistics were obtained for 1890, while the statistical enquiries covering other sections of the Atlantic coast I believe have not been complete so far as including all kinds of fish is concerned. The figures presented, however, showed an increase in the catch of mullet of 14,512,890 pounds; of sea-bass, 5,785,903 pounds, and of squeteague or weakfish, 6,876,893 pounds.

There was shown to have been a decrease in the catch of cod of 26, 403,539 pounds. I wish to say something about this. I feel that I can speak with some authority in regard to the matter, since, in 1879 and 1880, I was engaged in the statistical canvas of the coast fisheries of New England where the cod fishery is most extensively carried on, and in more recent years, I have had charge of the work of collecting and compiling fishery statistics for the government.

In recent years the market fishery of New England has grown enormously. The finest vessels of the fishing fleet engage in this industry from Boston, Gloucester, Portland and other ports. The fishery is at its height in winter and a large portion of the fish taken are haddock. At Provincetown, where there used to be a large fleet engaged in cod fishing on the Grand Bank of Newfoundland, that industry has to a large extent been superceded by this market fishery, which has been found more profitable than catching cod on distant banks. As a result of this change in fishery, the decline in the catch of cod has been more than counterbalanced by the increase in the take of haddock and allied species, by the market vessels. Thus, the combined catch of cod, haddock, and other species of the cod family is probably greater to-day, or was greater in 1892 than it was in 1880.

In this connection, it is pertinent to remark, as bearing upon the question of the increase or decrease of sea fish, that, twenty-five or thirty years ago, the taking of

haddock on George's Bank was only an incident of the fishery. I was there and can speak by the card. The market fishery for haddock on George's Bank began about 18 years ago, and a friend of mine inaugurated the fishery. He made the first haddock trip to George's. At that time a fare of thirty or forty thousand pounds of fish was considered a good catch, and fifty thousand pounds was something extraordinary. The fish taken were mostly haddock, though large quantities of cod were caught. Last March a considerable number of the market schooners which sell their catch at Boston, brought in fares averaging upward of 100,000 pounds of fish each. And in one instance the schooner *Indiana* landed a fare—the result of three days fishing—of 132,200 pounds. Think of it! Sixty-five tons of fish taken in three days fishing in the month of March!

Now, these are facts. I have no desire to give anything else to this Society, or to anyone else, especially the honorable gentlemen who are connected with the Pennsylvania Fish Protective Association. But I have felt impelled to cite these instances, in view of what Mr. Chamberlayne has said.

Now, sir, I do not know how other gentlemen may view this matter, but I contend the fishermen have a right to organize for the collection and dissemination of knowledge concerning the industry in which they are engaged. If they do that work faithfully, as I believe they will, they will add not only to the knowledge we now have, and help to produce the most accurate fisheries statistics, but they should be able to add vastly to the sum of our scientific knowledge. And why not? Where does the United States Fish Commission get its statistics, and its information concerning fisheries? From the fishermen. Where can the state fish commissions secure statistics, if they gather them, except from the fishermen?

Now, sir, there is this difference between the methods heretofore adopted and the scheme proposed by the fishermen for collecting statistics and information, and I do not make any secret of it. The plan of the Commercial Fisheries Association is to place a blank in the hands of every man who sails a vessel or boat, or who operates a pound net, gill net, or other forms of fishing apparatus. Upon these blanks a correct daily record of the catch will be made, at the time, when the facts can be put down with exactness, and statements will not be given from memory, six months to five years after the fish are caught, as has been the case heretofore. It is the purpose of this organization to impress upon every fisherman connected with it the importance and necessity of recording the facts with the utmost fidelity and accuracy. We want the truth, the whole truth and nothing but the truth. Who can ask more than this? The gentlemen who are interested in fish protection, and who desire a basis upon which to base honest conclusions, need the truth also. And I say that in doing this work, if it is honestly and intelligently done, the fishermen will act on correct principles. We must have the truth; nothing else will suffice to settle this question; and we propose to nail our flag to the mast on that issue. The fishermen propose to stand on the rock of truth, and I ask any gentleman here if he is content to stand elsewhere in this controversy?

My friend, Mr. Whitaker, has stated that it is proposed to begin "a campaign of education." I am glad of it. That is in line with what the fishermen intend to do. Their only safety lies in the education of the public concerning fish and fisheries. And who will protest against it? The United States Fish Commission has been doing this kind of work for twenty-three years, and it has received the commendation of the whole world for what it has done in that direction. The various state fish commissions will probably be

interested in this movement. And I say to you that the fishermen are willing to join in any honest effort to educate the public regarding the industries in which they are engaged. And who can object if they put up their money for this purpose? This work will not be done in the dark, nor under a bushel. It will not be done for any improper motive; it will be done for the purpose of gathering reliable facts, such facts as everybody can use to base just conclusions upon.

Now, sir, I have nothing to say against angling. Many of my friends are anglers, as you know. I recognize the fact that among the anglers of this country are men of the highest merit and the greatest ability. I also feel that any man who is interested in increasing the supply of food fish, whether he is an angler or a fish culturist, is engaged in a worthy work. But we are all human and we are liable to err in our judgment, under certain circumstances. Therefore, in behalf of the commercial fishery industries of this country, and having in view their magnitude, and the vast importance to the American public of their continuance, I say that it is well to be cautious about restricting coast and sea fishing, and it is better to be sure we are right before we go ahead. The fishing interests of this country have a special claim to the consideration of the American public, and a claim upon every man who in any way is interested in fish or fishing.

It is unnecessary for me to say to this audience that fishing was the first industry of the Western World. But for the deeds of the fishermen in Washington's army, we might never have gained the liberties we now enjoy. This is a matter of history, and should be familiar to everyone.

Millions of capital are invested in these industries, and thousands of men, women and children, depend upon them for their bread. The prosecution of the fisheries is hard enough at the best, as I know by dear

bought experience. All these things should be taken into consideration before we reach conclusions, or advise legislative action, which may hamper the fisheries and prevent the successful continuance of industries of great importance to this country. Speaking for myself, I want to say that before I will do a single thing in this connection that my conscience would reprove me for, I will cut off my right hand.

This is not my first appearance in public in connection with the fisheries. Nearly everyone here knows me; knows where I have been and what I have done. My feelings regarding these questions are the same to-day that they were when I was connected with the U. S. Fish Commission, and had the responsibility of gathering statistics and other data relating to the fisheries of the entire country. I am not a fanatic, as you might be led to believe, but now as then am willing to abide by the truth, and am open to conviction. I think that every honest and fair-minded man should be willing to meet these questions upon a basis of ascertained facts, and compromise on that basis if compromise is necessary.

HAS OUR CIVILIZAITON SUFFICIENT INSURANCE AGAINST FAMINE?

We live in an age of marvels, in a world of our own creation, with no land marks to guide, no beacon of past experience to adequately illumine our pathway. Invention follows invention, and discovery, discovery, each opening an immeasurable field for the effort of mankind, with the assurance of a corresponding addition to its happiness and well being. Luxuries undreamt of by our forefathers, possessed at first by the wealthy few, become the comforts of the many, and then in turn the necessities of all. The marvels of yesterday become the commonplaces of to-day, and in constant succession, new wonders, new triumphs encourage hopes almost beyond conception. Natural forces are revealed to be forthwith harnessed to our service and the industrial capacity of a hamlet is expanded to that of a city. Magazines of natural wealth, hitherto unseen or undisturbed, have been broken upon and the accumulated treasure of forgotten ages squandered without thought of the needs of any but ourselves. Standing upon the pinnacle of achievement and surveying a century's advance, we regard its nearing successor as fraught with triumphs as magnificent, with conquests as abiding as those which have forever glorified our own. Yet the powers of the human intellect have a limit upon whose verge we may not know when we stand, but up to its attainment await in hopeful confidence the development of resources that may ever be elusive or imaginary. Without regard, therefore, to the dimly foreshadowed possibilities of a doubtful future it behooves us to make the utmost of that which we have and with patient and

prolonged labor to accomplish results that perhaps cannot otherwise be attained.

Upon the land, man's dominion is supreme; its face, where fairest, he may scar, ravage and make bare, that stranger winds may come and wither it into an abiding desolation; he may reclothe his desert with its raiment of verdure, and if so willed, bend to his purpose every form of its animal and vegetable life. But need we longer say with Byron in his noble apostrophe to the ocean?

Man marks the earth with ruin—
His control stops with thy shore.

We who girdle its bed with thought-flashing cables, who in floating palaces skim its seas with birdlike speed and grace, who sound its remotest depths and reveal its uttermost secrets, we who do all this should be as little of the poet's mind as we are of his generation. Moreover the ruin of which he speaks has not stopped with the ocean's shore; beyond that dread-bound man has ravaged and despoiled, its harvests he has withered, and the blight of his hand lies heavier upon the sea than upon the land. For upon the scarred earth he has spread the cloak of his repentance, into her wounds he has poured the balm of peace, and with careful nurture and thoughtful ministration he brings her back to gladness and beauty. The sea is still the object of his rapacity, his destruction is constant, his warfare merciless and he sees not in his blind greed the shadow of the coming desolation.

Upon the land bitter experience has taught us that conservation is better than reparation and dumb indeed need we be if our lesson has revealed not only a new field for its application, but also the means of achievement. To obtain dominion over the dwellers of the sea, to set apart the available and destroy the harmful, to make the sea our preserve as we have the land our pasture, this should be our purpose, our ultimate hope.

Lost in the gloom of a vast antiquity, there must once have been a benighted savage who from the wild sea grasses about him chose that of the most promise. Its cultivation maintained with interrupted and oft-flagging effort, and prolonged through innumerable generations, resulted in the perfection of our first cereal, the barley of the present day. That pioneer agriculturist opened an immense field to the labors of his posterity, but only inferior thereto is that we may mark out for the generations that we hope are to follow in our footsteps. Unlike the land, the ocean has no absolute deserts, nor bears it a mere surface film of life, but in all its varying depths and in every portion of its vast waters it teems with animated creatures. Even where man has bereft it of its choicest treasure, its nursery remains, ready like the rich grasses of a far rolling prairie, to foster renewed swarms into being.

Agriculture is the development of an immeasurable antiquity, but with a larger intelligence, sustained with greater constancy of effort operating through a far less period, we may make pisciculture its handmaid, the twin dependence of that perfected generation to whom in vastly increased number we may hope is to descend the heritage of a gladder and a fairer earth. Generation by generation our social structure assumes greater harmony and efficiency of action, for within it there is a constantly increasing diffusion of the comforts, the luxuries and the knowledge of life, each and all tending to an ultimate equalization and balance of its various parts. This development of society, the most remarkable feature of our age, is the result of the greater division of its labor occasioned by the increased capacity of its food producers. No complex social structure, no great diversity of industry or amassing of wealth is possible in a community the time and energy of whose members is mainly absorbed in the mere production of food. In all civilized countries there has been within the last

century a far greater increase in the industrial than in the agricultural population, as is plainly shown in the enormous growth of cities and towns, a relative growth so steady and constant that it necessarily reflects a corresponding development of agricultural skill or capacity. It is this surplus of the food producer that has at every period of the world's history been the measure of its progress and prosperity, and the index of its accumulated wealth. For the labor of the agriculturist, if limited to his own needs, disappears with the enforced consumption of the product; it is only the excess that supports industries whereof the results assume permanence and constitute national wealth.

Among the innumerable forms of organic life there is everywhere a relentless struggle for the means of subsistence. Alike in the meadow and the forest, the rill and the river, the pond and the sea, there is neither blade of grass, nor towering tree, no bird, no insect, no walking or swimming creature whose existence does not imply the wresting of sustenance from the many that have perished. Even man, whose increase involves the destruction of so much that is below him in the scale of being, needs himself to bend to the mere acquirement of food the weight of his overmastering energy. Famine has ever been the scourge of his race, the spur of his industry and the dread school of his forethought and frugality. Equally with the humblest organism he finds his proper nutrition the object of his main endeavor, the occasion of a struggle whereof the gravity deepens with the coming and the going of the generations. For even with the utmost advance in scientific farming as indicated by the possibilities of agricultural bacteriology, there is reason to presume

To the reckless destruction of forests is largely attributed the famines of India and China, the aridity of much of Spain and Italy, and a measure of the depopulation of Asia Minor, and other portions of the East. The renewal of denuded areas in France and India has already accomplished remarkable results, which, however, are of little moment compared with the promise of the future.

that population will in the future tend equally as in the past, to press upon the means of subsistence.

The so-called intensive farming of the future which by some optimists it is hoped will adapt itself to the requirements of our industrious posterity, is very exhaustive, requiring constant replacement of materials abundantly absorbed. Modern tillage, although it has not reached the "intensive" stage is so extravagant in its demands that the earth is already practically stripped of its guano deposits and its remaining formations of nitre, mineral phosphates, etc., cannot very long continue to contribute to the needs of an insatiable soil. Even the fullest utilization of the sewage of our cities will suffice for the enrichment of but a comparatively limited area, nor can we adopt the reparative methods of the Chinese without a very material sacrifice of the comforts and decencies of our civilization. We who stand in its fullest effulgence, and accept it as the ordinary and natural outcome of our lives need to occasionally avert our eyes from its glare and regard the shadows from which we have emerged.

In the world's history the problem of the subsistence of its greatest aggregations of humanity has been generally solved by the various agencies of war, pestilence and famine. The duration of no agricultural nation of antiquity of which we have record was sufficient to evolve a distinct civilization, save those that occupied the valleys of the Euphrates and the Nile. Century after century for thousands of years the annual inundation of their vast bottom lands yielded the Assyrians and Egyptians a stream of sustenance as steady and constant in flow as that of the fluvial arteries whose pulsations were the nation's life. Elsewhere, primitive methods of tillage were insufficient to sustain

England, where scientific farming most generally prevails, absorbs nearly the whole of the Chilian nitre production, and receives the greater part of our export of fertilizing material, now amounting in monthly value to nearly \$400,000

large populations, and the growth of agricultural knowledge, while it prolonged, could not render permanent the food capacity of the soil. Nor has modern science devised means of compensation that are steady and lasting, although there is a possibility that by the culture of nitrifying bacteria, the requisite supplies may be obtained from the nitrogen of the atmosphere. The problem is one of gravity, for not only is the soil divested of its nutritive salts by the growing plant, but every drop of rain that finds its way to the nearest water course bears to the all-devouring sea a portion of the treasure that man seems impotent to conserve. To that ravening sea, therefore, the apparent bourne of all terrene substance, must he have ultimate recourse ; there must he regain some measure of that of which he is incessantly drained.

It is a century since Malthus startled a blissful world into the consciousness of an impending calamity, and, although the baleful spectre that he then invoked has receded before the advance of an ever-expanding knowledge, it yet lurks in the shadows of a fateful future. It was his contention, as it is that of many thoughtful men, that the steady increase of population tends to the exhaustion of its alimentary resources, and that the utmost development of its limited area of tillable land would ultimately be inadequate to satisfy the demands upon it. Apart from the accomplishments of modern science, there were certain factors that he disregarded, and the catastrophe was therefore made to appear of woeful imminence, but with its relegation to posterity public interest subsided. However remote may be the day that dawns upon a famishing and a diminishing world, there can be but little doubt that its substantial deprivation of animal food is a near contingency. In the dietary of the great bulk of its population it already has no place, and but rarely in the greater portion of the remainder. Meat affords a stimulating

food, and seems to be the fit and proper aliment of a nervous and energetic people to whose greater vehemence and combativeness do those succumb of whose sustenance it forms no part. Nevertheless, fish will need to become the only resource of posterity against the inevitable deficiency of the more potent aliment, a lack that will be hastened by the diversion of grazing lands to the food requirements of an increased population.

Meanwhile, like the overspreading of pent up waters, wave upon wave of humanity is dispersed over the bosom of our fruitful earth whose utmost gifts are to be absorbed by the multitudes it calls into being. Where population has long been dense it is, under the fostering influences of civilization, becoming denser; the teeming throngs of Bengal and of further India undergo a steady increase. So also in Europe and our country the better condition of the poor first reflects itself in ampler nourishment and a constant increase in national wealth infers, even with a stationary population, a steady increase in food consumption. In South Africa formerly uncultivated or abandoned areas are filling up with fast multiplying tribes, who, in peaceful security, till the responsive soil with assiduous industry and care. No longer devastated by warlike clansmen who before British occupation or rule enslaved, slaughtered and devastated at will, the country promises to become the eventual support of millions where hitherto it has sustained hardly more than thousands. In temperate South America and Australia, as well as in Siberia and the Canadian Northwest, the occupation of the country

I. It is the forceful fuel of an intense age; but with the fullest development of the world's resources and the diminished field for the exercise of its energy, the need of a flesh diet may cease with its loss. Although, apart from its greater proportion of water, fish has substantially the same composition as flesh, it lacks the stimulating power occasioned by the assimilation of animal tissue identical with our own.

Animal flesh, as is well known, when fed to animals, tends to their greater ferocity, but in Norway fish offal frequently becomes cattle fodder, and at the extremity of Cape Cod, within the memory of living men, a herd of cows were similarly fed without impairment of their gentleness or docility.

to its fullest extent by an agricultural people is simply a question of time. Thus will it ultimately happen that from the earth's lesser waters as well as from its all encompassing oceans, bordered everywhere by an industrious and enlightened population, will be drawn the deficiency of a burdened soil. That vast reservoir of marine life whose mere waste immeasurably exceeds the need of mankind can, under its wise and provident ministration, renew its treasures with unfailing abundance and thus to a remoter period may be deferred the apparition of gaunt famine stalking through a decaying world. To us the ocean is what the wide spreading prairie was to the Indian hunter, a free field for the exercise of indiscriminate slaughter, destruction and waste, but henceforward it is to be regarded as the common possession of mankind whereof the advantage of the individual is to be subordinate to that of the race. The code that will administer, conserve and apportion its benefits may be like that governing mining and irrigating industries—the growth of time—but the world will yet co-operate in a harmonious development and distribution of its common resources. The science of water farming will absorb a material share of its effort and talent, and make of the ocean a field for the maintenance, development and improvement of that which is of value and the elimination of that which is harmful. Our fisheries may not yield upon the invested capital a greater return than that of the farming interest, and the marine food producer contribute no more to the common alimentary stock than the average agriculturist. The vessels and apparatus employed are costly, and their destruction or impairment, and the loss, entire or partial, of the crew is an abiding contingency. In this respect we may be likened to our primitive ancestors, who ventured into the remote wilderness upon precarious

II. The well doing of the humble ryot moreover enabling him to eat two meals a day where formerly he ate but one.

expeditions resulting sometimes in the killing of the urus or wild boar and sometimes themselves. Both of these animals, prototypes of our cattle and swine, were domesticated by some discerning savage whose more certain possession of adequate subsistence insured the elevation of his descendants in the scale of being. With the proper exercise of patience and skill, and the assured acquirement of due knowledge, we will cease to need to wander in remote and storm-tossed seas for fish we can secure in safety and abundance at our doors. The possibilities of fish culture are boundless, and their expression may awaken the same measure of incredulity as was occasioned twenty-five years ago by the preliminary efforts of the Fish Commissioners to stock the Connecticut river with shad. Yet a few seasons later the resulting abundance was so extraordinary that the erstwhile scornful fishermen begged the Commissioners to desist, urging that it was useless to hatch fish beyond the absorptive capacity of the markets. Refrigerating appliances and improved facilities of transport, however, widened the market, and more effective appliances of capture soon enabled the rapacious fishermen to change the surplus into a lamentable deficiency.

A full recognition of the plasticity of all organisms, of the readiness with which their form, structure and habits adapt themselves to external influences, and are thus altered for the better or the worse, is one of the great developments of our century. A dim appreciation of the truth has been discerned and acted upon from time immemorial, but until the last generation no adequate conception of its possibilities dawned upon the minds of men. What the intelligent breeder has done we all know. With cattle it has been said that an ideal form chalked upon a wall, by patient effort and skill, by an acutely discriminating selection and avoidance of all but imperceptible divergencies, has resulted

in the attainment of the projected form. In one direction an endeavor to so alter and adapt the bony frame-work as to enable it to sustain the utmost possible amount of finely marbled beef has given us our massive short horns and Herefords; in another we have the small and graceful Ayrshire or Jersey so modelled as to give the largest development of udder; and to each and all there has likewise been imparted increased docility and gentleness. Our fruits and vegetables, under judicious and enlightened culture, have also undergone astonishing improvement, but the promise of the future is far greater than the accomplishment of the present. Having moulded animal and vegetable forms so nearly to our taste, it remains for us to attempt as much with our fish. Can we not also with painstaking endeavor so modify their habits, form and structure, in accordance with our desire? We certainly, from our success in similar lines of effort, lack no encouragement apart from what has already been accomplished, affording sufficient demonstration that fish lend themselves as readily to the breeder's skill as do other forms of life. Fish kept in so called tanks in India have been observed to become superior in size and of more brilliant coloring to those left in the rivers. This change has probably been effected by the selection of the smallest and most unattractive, leaving to the larger and more brilliantly colored the continuance of their kind. Carp, doubtless for the same reason, have assumed beauty of appearance and increase of size, and if considerations of table utility had prevailed over those of mere show, we would have possessed an uglier but more toothsome fish. Goldfish are a striking instance of what breeding and intercrossing can do, there being upwards of one hundred distinct varieties, all apparently evolved from a common dark colored stock. The various splendid colors, the diversity of form and other peculiarities have been developed by careful selections, and the persistence

of some characteristics point to a culture prosecuted from a remote period of time. Moreover, the ancient Romans practised the art with success. The famous pro-consul Lucullus bred so great a variety of peculiar fish that his stock was sold for \$150,000 of our money, and under the empire choice breeds were conserved by the wealthy with the same jealous care that a modern fancier bestows upon a rare strain of fowls.

Until the present century the improvement of our domestic cattle was due to what was in large measure unconscious agency. In slaughtering, the best would be reserved, the most abundant milker would be longest spared the butcher's knife, and so bearing a larger progeny would tend to the displacement of inferior breeds. Even this crude and unintelligent mode of improvement we have not applied to our fish, but select the largest and best and leave to the poorest the propagation of their kind. Once a year the ancient Incas of Peru held a great hunt at which the best animals were spared and only the inferior were killed. The old Scotch nobility pursuing, it is so said, the contrary method, despatched the noblest stags and largest does and found themselves the ultimate possessors of an impoverished and degenerated stock. Market fishermen cannot be expected to sacrifice immediate for ultimate gain; their need is pressing; they have families to support; and relentless competition necessitates their destructive methods. Avenues of ordinary and common human effort that are open to all become crowded to the limit of individual subsistence, and of such exigency selfishness and rapacity is the inevitable outcome, the contrary manifestation being at variance with human nature. Legislation is inoperative, its enforcement being difficult and unsustained by public sentiment. Hence, under the present system the exhaustion of our fisheries is unavoidable, and the only apparent alternative is State ownership and operation of all appliances of

wholesale capture, whether fixed or floating, in land or off shore waters within three miles of the coast. Only by the removal of all opportunity of individual enrichment at its expense can the community adequately protect itself, and the administration of its resources must therefore be in its own hands. With the careful and provident conduct of our fisheries, by intelligent and responsible agents, supply will be better adapted to demand, the terrible destruction of immature fish will cease, and a sufficiency of spawners be permitted access to their breeding places. No longer controlled by the ignorant and reckless, thoughtful observation will constantly tend to a wiser and more judicious cultivation and to the ultimate adoption of methods of scientific intercrossing and breeding.

Sustained by as keen an observation and discrimination of varieties of development, and with the possession of the requisite means and appliances, the successful breeding of fish ought to be of speedier accomplishment than has been that of our domestic animals. For the greater fecundity of fish gives a far larger range of selection, and their early maturity a more frequent means of its exercise. These advantages may possibly be offset by deficient opportunity of observation and comparison that fish afford even in confinement. But with due facilities, there can be no question as to the attainment of results amply justifying whatever of time, labor or care the effort may involve.

Among the ancient Romans the breeding of fish was a pastime as well as a useful occupation, and with the wealthy a costly indulgence, initiated at an equivalent of hundreds of thousands of dollars of our money. Their vivaria were a great advance upon the *piscina* or ordinary fish ponds, being walled with marble tiles,

III. The Inca system of state ownership and administration of useful *fera natura* seems with due modification to be the only one adapted to the proper conservation of our fisheries.

and having cemented bottoms, or else hewn out of the solid rock, and deepening at their further extremity into a cool and shaded grotto, to which the finny flock could retire in comfort and repose. The site adjoined the sea, and the form of the excavation was so designed as to insure a ready circulation of the contained water, its discharge and admission being effected by canals leading to opposite ends. Its constant freshness and purity was further maintained by the planting of sea weeds, rocks and stones bearing algae being scattered upon the bottom, thus anticipating the principle of the modern aquarium. The Roman culturists devoted their efforts to the propagation of fish attractive in color or extravagant in form and appearance. Most of their bizarre and fanciful productions were probably hybrids, and the enormous prices at which some of the collections were sold indicate a widely diffused appreciation of the art.

The possession by our rich of similar tastes, and their maintenance of marine aquaria as accessories to their sea-side villas, even to the displacement of breeding kennels and stables, would be of no prejudice to them and of probable public advantage. With activities quickened by the sense of exercise in virgin fields, and directed with intelligence and discrimination, the accomplishment of the modern culturist, if not so startling, would undoubtedly be of more value. Not only would such aquaria afford their wealthy supporters amusement and instruction, and possibly material profit, but tend also to further the science of marine biology now lagging in slow progression behind its fellows. Their interest, and also that of the community, needs, however, to be stimulated by the establishment of a public marine observatory, with ample appointments, and constructed upon an extensive scale. Such an aquarium should be under the constant care and observation of men of learning and acuteness, who would devote their knowledge and acquirements to the study and useful

development of marine forms, and also impart instruction to those qualified to learn. In short, an amply equipped college of biology, pisciculture and kindred branches of study, should be established upon the most liberal scale in a locality the natural advantages of which would insure its most economical construction and maintenance. Among the various branches of practicable effort that such an institution would facilitate may be mentioned the acquirement of knowledge as to the habits, mode of spawning of deep sea fishes, and also the acclimatization of edible fish of warmer waters. The elimination of the migratory instinct in the land-locked salmon of Maine, in the Canadian Winninnish, and also in the fresh water smelt of our own and of other lands, suggests another. During the first third of the present century the streams running into Lake Ontario swarmed in their season with myriads of salmon, farmers pitch-forked them upon the banks and sometimes at night their teams would kill them at the fords, the frightened horses plunging through dense masses crowding in darkness over the shallows. The choking of the streams with nets soon made the salmon a reminiscence, and to this day it is disputed whether they journeyed from the deeps of the far distant sea, stemming the swift current and swifter rapids of the mighty St. Lawrence, or whether they were residents of the great lake itself. We know, however, that the migratory instinct has become dormant in many anadromous fish, and there is reason to believe that their permanent adaptation to fresh water has been effected by natural agencies operating through a brief period.

If the swarming menhaden of our coast could be gradually replaced by a variety in which the wandering impulse was absent much would be gained, nor need it seem visionary to attempt its ultimate development into a valuable food fish by the constant addition of improved varieties obtained under culture. Although

we would need to bequeath its accomplishment to posterity, its initiation is commendable; for, apart from the enlarged conception of duty imposed by the enlightenment of our age, the stream of accruing advantage, at first imperceptible, would steadily broaden to its full measure of beneficence. Nature does not advance "per saltum." Neither the animal or fish breeder can hope to develop marked deviations from existing varieties save with assiduous care and prolonged effort, and the highest intelligence devoted to that end is certain of reward. Our splendid civilization is based upon the humble beginnings of remote ancestors and enlarged by the intermittent labors of innumerable generations, the accumulated results of which it is ours to enjoy. That perfected stage that is perhaps to be the heritage of our posterity might have been the present, if each generation of even our own era had been endowed with a sense of the duty that it becomes us to exercise.

It is by some maintained that the world's wheat crop of 1893 was inadequate, but if the shortage should be sufficient to advance prices, the crop of 1894 will be that of an increased acreage. If a century or more hence a deficiency should occur with the utmost development of the earth's agricultural resources, a second year of scanty production, in the absence of an

IV. Invariably by friend and enemy alike the English are described as the fiercest people in all Europe (Benvenuto Cellini calls them the English wild beasts) and this great physical power they owed to the profuse abundance in which they lived. A sturdy, high hearted race, sound in body and fierce in spirit, and furnished with thews and sinews which under the stimulus of "those great shins of beef" were the wonder of the age. Froudes' History England Vol. I, Chapter I. Their food consisteth principally in beef and such meat as the butcher selleth whereof the one findeth great store in the markets. Harrison's Description of England, page 282.

V. Despite local famines estimated to have carried off directly or indirectly several millions, the population of India, according to the census of 1891, increases 30,000,000 with the previous decade.

VI. Every year in some portion of the empire 50,000 or 60,000 of its people were gathered in an immense circle under the direction of some high official or of the Inca himself. Within this contracting cordon all harmful animals were destroyed, the male deer and the poorer wild sheep were slaughtered and the skins and meat distributed. The better sheep or Yicunae, after shearing, were let go, as were also the does and fawns. No one section was allowed to be hunted oftener than once in four years, and then only under government direction and supervision. See book I, Vol. I, Prescott's Conquest of Peru.

alternative harvest, might occasion direful results. Famines periodically visit China and yet in various parts of that kingdom fresh fish is so cheap as to sell at the same price as wheat, and but little below that of rice, the abundance resulting from a comparatively rude method of pond culture. It becomes our superior civilization to extend better and more scientific methods, not only to our own inland but also to our marine waters, to endeavor to regulate, govern and direct the produce of the larger areas as systematically as we would the smaller. Water farming implies some methods of marine to those of terrene culture, certainly the encouragement of the growth of that which is good and the repression of that which is noxious. The grazier whose herds suffer devastation receives a measure of protection from the community, which is extended as an obligation to its members, and the bounties offered for the destruction of beasts of prey should also be applied to that of marine food destroyers. A few years ago a company prosecuted with several steamers a fishery for sharks, dog-fish, porpoises and other destructive fish, their conversion into oil and guano promising a sufficient return. This expectation being disappointed, the fishery was abandoned, but its renewal under assurance of bounties should be thought worthy of encouragement. The extermination of predaceous fish is not to be hoped for but, inasmuch as man's consumption of edible varieties is but a fraction of that of their marine enemies, the abatement of the latter as a public advantage merits public support. The substantial elimination of the formerly plentiful halibut from the New England coast necessitating its pursuit even into Polar seas, demonstrates what can be effected by the constant capture of a predatory fish. With the persistent exertion of fostering care upon the one hand and steady repression on the other, he is not a vain prophet who would predict of our marine waters the

ultimate acquisition of an ample spoil lending itself with constant ease and unfailing abundance to the requirements of man. So may it be said that expansive seas, forming carefully cultivated and guarded preserves, teeming with alimentary treasures varying with the season, and in form and variety, in habit and structure best adapted to their needs, will be the assured possession of a near or a remote posterity unless civilization wanes and population declines.

Through the glass of eternal time slip slowly the century's closing sands, and the mighty stream of its effort seems to slacken and to dwindle with the ebbing of its years. During its course there has been a revelation of the earth's resources so startling to eyes long clouded by ignorance and doubt as to occasion an era of feverish development, of strained and intense exertion of the powers of our race, such as the world will probably never see again. Never before were the energies of mankind so expanded in magnificent achievement, and never before may it in sorrow be added were they exerted so wastefully and so destructively. The century to come will be more of conservation than of development, of maintenance rather than of progress, but still of continuous advance. To the reparation of our errors will be devoted much of the endeavor of our posterity, who will nevertheless honor us for much that we have accomplished for ourselves without thought of them as the ultimate beneficiaries. They will, however, hold those more worthy and deserving of a larger measure of gratitude who, with wise and provident foresight, sought provision for their eventual advantage and well being.

THE PRESSING NEED.

BY CHARLES F. CHAMBERLAYNE.

MR. CHAIRMAN AND GENTLEMEN:

Precisely in what way one not a fish culturist could add anything of value to your deliberations has been to me something of a puzzle. But in the confessed need for adequate restrictive legislation, law and fish culture join hands and the law makes, I am pleased to believe, a contribution of no mean value to our cause of fish preservation. In taking up, briefly, the question as how best to secure and enforce such legislation, the fact which first and most strongly impresses us is this: That while the necessity of restriction is adequately recognized, it is not always remembered what enormous changes time has wrought in the number, energy and resources of those whom it is thereby sought to restrain.

The early enemy of fish preservation was the poacher. Now the poacher was usually a poor devil of small social, personal or financial standing. His ravages were limited in extent and usually for his personal eating, an offense against society which the state of his pocketbook frequently explained and almost excused. Even where his illegal fishing was done for market, the slow transportation of early days effectually restrained the extent of his depredations. With the law, the early poacher was not on easy, much less friendly, terms. To him it was invariably an enemy. He met it usually in the justice's court, and it meant merely fines and frequent imprisonments. Voluntarily, he never darkened the halls of legislation. All he asked of the law was to be let alone. Ostracised socially, not financially, wrong legally, early society felt itself amply able to protect

itself against the poacher. Whether it is also able adequately to protect itself against the poacher's successor in interest still remains to be demonstrated.

This gentleman of modern days is a radically different sort of person. He has money, intelligence, social position. The world's progress enables him to carry on the work of fish culture on a scale the poacher never could have dreamed. The power of steam and of an apparatus unequaled in destructive efficiency vastly augments his catch. Not even these keep pace with the broadening of his market. Swift freights carry fish to the great centres of population where steady and remunerative demand is certain. If these fail him, refrigeration gives him a continent for his wares. Canning offers him a chance to save much of the balance. He has much to work for and a good deal to work with.

All this means much to the situation. In the first place it gives the poacher's successor allies and supporters the poacher never could have had. The men who sell his fish or can them are bound to be his friends. If he is a good shipper he can count on the open or covert assistance of the transportation companies who profit by his freights. Hotel men and many others who want fish and are not particular where they come from and when they are caught ; the persons who sell nets, seines and other equipments ; those who buy, sell or are interested in the "by-products" of the fisheries in oil, guano, etc., these and many others stand together for the "Commercial Fishermen," as they are fond of calling themselves, their right to capture fish in any way and at all times.

More than this, the modern enemy of fish preservation has learned a fact the poacher never knew or perhaps, rather, was never able to avail himself of, and that is that killing fish by law making is easier, safer and better than killing fish by law breaking. Fish preservers no longer have law making to themselves. It was the sting of the

poacher's position that it was illegal. The "Commercial Fishermen" are in the market for laws benefitting their business, and against all laws restricting it. Their money gives them the aid of the purchasable lobby, the chance to ascertain and even occasionally to manufacture so-called "scientific opinion"; it purchases the skill of excellent counsel and possibly the rural part of the Legislature. Precisely the influence which makes good laws increasingly necessary, also makes it increasingly difficult to secure them.

As important and indeed necessary means to getting the legislation they want, the "Commercial Fishermen" are firmly and constantly using, with great perseverance and judgment, two important aids to any work: (1) Education; (2) Organization.

(1) The poacher never attempted to educate the public to his view of the situation. But the "Commercial Fishermen" appreciate that in a country where public opinion governs, the ultimate conditions of fish preservation will be determined by the general feeling of the people. A "Campaign of Education," therefore, is an essential part of the system. Listen, gentlemen, a moment, and you can hear the din of the work as it daily progresses. Every vehicle for reaching the public ear is carefully utilized. The press, the platform, the magazine, official, semi-official and private publications, are made the cover for reaching the people. The burden is always the same. The "theories" of fish preservers are computed by the so-called "facts" of the fishermen. Scientific statements, like those of Huxley and others, violently wrenched from their connection, and all necessary qualifications are forced to masquerade in novel and incongruous company to support propositions they really antagonize. Misleading and frequently false "statistics," "averages," etc., serve to give an apparently scientific flavor to the whole. That fish are not decreasing and indeed are indestructible; that every

fish caught is a fish gained and every fish saved is one lost to the community; that the fish destroyer is the "poor man's friend," and that fish preservation is the work of "dudes" and "sportsmen;" that the State and National Commissions, searching for truth from reliable sources, without bias or improper motive, are "theorists," while those who are endeavoring to support foregone conclusions, intensely profitable to themselves, by the best evidence they caught, are the "practical" men relying on demonstrated facts; that if "free fishing" were only ordained, the farmer would raise unlimited cotton, wheat and other crops with cheap fertilizers; the shoemaker get cheaper oil, and everyone be content and happy; such is the literature with which the combination is flooding our people and driving into their heads. All these constitute what these gentlemen call a "record," and is implicitly appealed to as such.

(2) This shrewd and careful, farseeing and persistent work can only be carried on by *organization*. An association of poachers would have been as unheard of as "Coxey's Army." But the "Commercial Fisheries" firmly believe in organization. No trade interest is better organized. To all the natural instincts of self interest urging union for mutual protection, is added that of a common danger—that of restrictive legislation. It was a significant circumstance to my mind that at the New York Conference at the Gerlach House, in December, 1893, while those in favor of fish preservation came largely as individuals, the pound fishermen, the net and twine men, the fertilizer men, the wholesale market men, the fish commission merchant, etc., usually appeared as the representatives of Associations—National, State or Local—and frequently by excellent counsel. The trust aggregation called the "United States Menhaden, Oil and Guano Association," under

intelligent management has carried on its work with a smoothness and completeness which may well serve as a model.

It covers the Atlantic States; it assesses itself liberally. Any attack on the interests of the Trusts in any State meets the entire force of the aggregation. The armory of so-called "facts" is judiciously drawn from.

"I once saw the Association at work at its best—in Washington—with its fertilizer allies, its net and twine allies, its wholesale fish market allies, its porgy oil friends, under the eye of the President of the Association. It was a beautiful piece of work. The co-operation of the Speaker of the House of Representatives had been secured by a pledge of support; a favorable committee had been appointed. At the hearing before this committee, witnesses, well drilled, well dressed, with neatly written rolls of so-called 'statistics,' were present in crowds. The press was utilized as usual, and marked copies were distributed where they would do good. Doubtful members were deluged with 'resolutions' from their constituents.

"They failed, indeed, but through no fault of theirs. They have a good memory for those who accomplish their defeat. They do not propose falling over the same stone twice. They were opposed by Doctor E. W. Gould, a Fish Commissioner of Maine, and Hon. A. E. Pillsbury, Attorney-General of Massachusetts. Mark the sequel.

"Last year Mr. Pillsbury, by far the ablest candidate in the field, offered himself for the Governorship of Massachusetts. The Association's counsel at Fall River carried every caucus of that city against him, and confessedly accomplished his defeat. When Dr. Gould's term as Fish Commissioner expired, the influence of the representatives of the Association succeeded in preventing his reappointment. Such work as this must in the

end succeed, unless opposed by equal skill and industry. It almost deserves to succeed

"It is unnecessary to defend the value of organization. No one can have seen and felt the splendid sense of honor in a body of disciplined troops, marching responsive to a single will ; throwing against any enemy and in any direction the force of a united effort and failed to realize the immense superiority over any disorganized and indisciplined body of men. The latter may, individually, be equally brave and equally gallant, but there is a something, a power of co-ordination, an economy of effort, a something beyond the sum total of the individual units which makes it clear that no guerrillas, however spirited, can long contend against regular troops.

"A few days ago, this effort at organization on the part of those interested in fish destruction culminated in the formation of what is known as the "Commercial Fisheries Association," a national organization under the leadership of Capt. J. W. Collins, who thus happily has found a field of usefulness for his admitted talents without compromising his former associates of the United States Fish Commission. The fishing interest and all allied interests unite their money and influence against "unjust interference by those who erroneously assume that the methods of capture now employed tend to decrease the fish food supply."

Now what are we, on our side, doing to meet all this ? Alas ! but too little !

"We, on our part, have, strictly speaking, no inter-State co-ordination. If New York desires to protect the Great South Bay, for example, from the use of purse seines, the entire force in men, money and 'facts' of the opposition is available to fight her movement. But, on the other hand, the effort gets no men, money,

or 'facts' from New Jersey or Massachusetts, and the latter have, in their turn, to fear a united resistance to any attempt to protect their waters.

"The difficulty extends to the different sections of the State. Excellent organizations protect fish in many of our States, but seldom is there any general union of such organizations capable of delivering a blow with united strength and knowledge of all. In my own State, if Buzzard's Bay is attacked, she fights her own battle single handed, and renders no assistance to any other waters. In fact, our people would hardly know how or where to appeal for assistance. No section has adequate means of knowing who its friends are in other sections, or how a suitable influence can be applied by a non-resident legislator's constituents to quicken his zeal. Therefore, in matters of general legislation, the friends of fish usually do nothing to oppose bad legislation until it is too late. Just here organized devotion to a single end shows its superiority to spasmodic efforts, however spirited. The personal interest of the Commercial Fisherman is sufficiently intense to enable him to take time by the forelock.

DEFENSIVE ORGANIZATION NECESSARY.

"Fish preservation must organize, and its armory of weapons must be equally good as its cause is infinitely better. It is always easier to criticise than to create. But I venture a suggestion. Each State needs a federated organization of local clubs. These local clubs should still control and carry on the work in their respective fields.

"But for the general interest of the cause, every local club should have a representation in some central organization, proportionate to its membership; should contribute a stated sum per member to the treasury of the central organization, which should employ and

suitably pay counsel for responsibility for legislative results, and a general secretary to keep an accurate record of all those interested in fish and game preservation through the State, and employ the funds of the Central Association, as directed, for the distribution of appropriate literature adapted to the creation of a healthy public opinion on this very important subject. These central federations, in turn, should be entitled to membership, in certain established proportions, in an inter-state body which, either directly or through an executive committee, could direct in questions of national legislation or inter-State regulation and the general objects of the cause of fish culture and preservation. The expenses and salaries, if any, of such an inter-State Congress or Board of Management, should be paid from the State Central organizations represented.

"There is nothing novel about such an arrangement. It is merely carrying into fish culture the methods of political organization. The fact is hardly an objection. Whatever object depends on legislation is, in a sense, political, and the political organization has proved itself the most efficient means of uniting many minds and many mites to produce legislation, and that is what we are after.

"It may be further objected that such a plan implies work and raising money. Such is the fact. But when it is remembered what fish preservation means to us as a nation; that cheap, healthful, and abundant food for the poor and all classes of the people; the livelihood for hardy fishermen and boatmen; the industrial prosperity of many sections of our States; mental relaxation for the toiling workers of our cities in all the busy pursuits of our intense and intensifying daily life; that these and many other objects of vast importance, socially, morally and financially, are involved in preserving the bounties of nature for the enjoyment of the present and use of

the future, it is not too much to hope that, in spite of local jealousies, and even at some little expense, the broad-minded, free-handed American people will adequately support with their good will and a little money, a thorough, well considered and efficient plan of fish protection. In providing such a needed plan, and in carrying it out to a successful termination, no agency would be so adequate and so well calculated to attract immediate and wide-spread support as the honorable society that I have had the honor of addressing."

LIST OF MEMBERS
OF THE
American Fisheries Society

COMPILED FROM CASH BOOK AND ACCESSIBLE PUBLISHED ROLLS

By R. O. SWEENY, Sr.
TREASURER, 1894.

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Behr, E. von Schmoldow, Germany; President of the
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Borodine, Nicholas, Delegate of the Russian Associa-
tion of Pisciculture and Fisheries, St. Petersburg,
Russia.
Borne, Max von dem, Berneuchen, Germany.
Huxley, Prof. Thomas H., London; President of the
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Jones, John D., 51 Wall Street, New York.
St. Clair Flats Shooting and Fishing Club, Detroit,
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Anglers' Association of Eastern Pennsylvania.

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Birbeck, Edward, Esq., M. P., London, England.
Benecke, Prof. B., Conigsberg, Germany; Commissioner
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Brady, Thomas F., Esq., Dublin Castle, Dublin, Ireland; Inspector of Fisheries for Ireland.

Chambers, Oldham W., Esq., Secretary of the National Fishculture Association, South Kensington, London.

Day, Dr. Francis F. L. S., Kenilworth House, Cheltenham, England, late Inspector-General of Fisheries for India.

Fedderson, Arthur, Viborg, Denmark.

Giglioli, Prof. H. H., Florence, Italy.

Hubrecht, Prof. A. A. W., Utrecht, Holland; Member of the Dutch Fisheries Commission, and Director of the Netherlands Zoological Station.

Ito, K. Esq., Hokkaido, Cho., Sapporo, Japan; Member of the Fisheries Department of Hokkaido, and President of the Fisheries Society of Northern Japan.

Juel, Capt. N., R. N., Bergen, Norway; President of the Society for the Development of Norwegian Fisheries.

Landmark, S., Bergen, Norway; Inspector of Norwegian Fresh Water Fisheries.

Lundberg, Dr. Rudolph, Stockholm, Sweden; Inspector of Fisheries.

Macleay, William, Sydney, N. S. W.; President of the Fisheries Commission of New South Wales.

Maitland, Sir J. Ramsay Gibson, Bart., Howietown, Stirling, Scotland.

Malmgren, A. J., Prof., Helsingfors, Finland.

Marston, R. B., Esq., of London, England; Editor of the *Fishing Gazette*.

Olsen, O. T., Grimsby, England.

Sars, Prof. G. O., Christiana, Norway; Government Inspector of Fisheries.

Smith, Prof. F. A., Stockholm, Sweden.

Sola, Don Francisco, Garcia, Madrid, Spain ; Secretary of the Spanish Fisheries Society.

Solsky, Baron N. de, St. Petersburg, Russia ; Director of the Imperial Agricultural Museum.

Trybom, Filip, Dr., Stockholm, Sweden.

Walpole, Hon. Spencer, Governor of the Isle of Man.

Wattel, M. Raveret, Paris, France ; Secretary of the Societe d' Acclimation.

Young, Archibald, Esq., Edinburgh, Scotland ; H. M. Inspector of Salmon Fisheries.

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Benkard, Jas., Union Club, New York.

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Bissell, J. H., Detroit, Mich.

Blackford, E. G., Fulton Market, New York.

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Butler, W. H., 291 Broadway, New York.

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Carey, Dr. H. H., Atlanta, Ga.

Cheney, A. Nelson, Glens Falls. N. Y.

Clapp, A. T., Sunbury, Pa.

Clark, F. N., Northville, Mich. (U. S. F. C.)

Collins, J. Penrose, 850 Drexel B'l'd'g, Philadelphia, Pa.

Clark, A. Howard, Nat'l Museum, Washington, D. C.

Collins, Capt. J. W., Laurel, Md.

Comstock, Oscar, Fulton Market, New York.

Conklin, W. A., Central Park, New York.

Cox, W. V. Nat'l Museum, Washington, D. C.

Crook, Abel, 99 Nassau St., New York.

Crosby, Henry F., Box 3714, New York.

Clapham, Thos.

Chase, Howard A.

Chamberlayne, Chas. F.

Demuth, H. C., Lancaster, Pa.

Davis, W. H.

Downs, H. D., Birmingham, Conn.
Dean, H. D., Leadville, Colorado.
Dewey, J. N., Toledo, Ohio.
Dieckerman, Geo. H., Newhampton, N. H.
Donaldson, Hon. Thos., Philadelphia, Pa.
Doyle, Hon. E. P., 53 Broadway, New York. (N.Y.F.C.)
Dunning, Hon. Philo, Madison, Wis.
Douredoure, Bernard L. 103 Walnut St., Philadelphia, Pa.
Davis, H. W., Detroit, Mich.
Dean, Dr. Bashford, Columbia College, New York.
Earll, R. E., Nat'l Museum, Washington. D. C.
Ellis, J. F., Washington, D. C. (U. S. F. C.)
Endicott, Francis, Tompkinsville, N. Y.
Evarts, Chas. B., Windsor, Vermont. Deceased.
Fairbank, N. K., Chicago, Ill.
Fergusson, T. B., Washington, D. C.
Fitzhugh, Dan'l H., Bay City, Mich.
Foord, Jno., Editor *Harper's Weekly*, Brooklyn, N. Y.
Ford, Henry C., 1020 Arch St., Philadelphia Pa. (Pres.
Pa. F. C.)
French, Asa B., South Braintree, Mass.
Frismuth, E. N., Jr., 151 N. Third St., Philadelphia, Pa.
Freas, Jno. A., 213 W. Chelton Ave., Philadelphia, Pa.
Foulds, Dr. T. H., Glens Falls, N. Y.
Garrett, W. E., Lyons, N. Y.
Gay, Col. Jno., 1020 Arch St., Philadelphia, Pa. (Sec'y
Pa. F. C.)
Gilbert, W. T., Plymouth, Mass.
Goode, G. Brown, Nat'l Museum, Washington. D. C.
Gavitt, W. S., Lyons, N. Y.
Gunkel, J. E., Toledo, Ohio.
Garman, S., Mus. Comp. Zool., Cambridge, Mass.
Greusbach, Jno. A., New Rochelle, N. Y. Deceased,
Sept., '92.
Haley, Albert, Fulton Market, New York.
Haley, Caleb, Fulton Market, New York.

Hagert, Edwin, 32 N. Sixth St., Philadelphia, Pa.
Harper, Thos. B., 709 Market St., Philadelphia, Pa.
Harris, Gwynn, Washington, D. C.
Harris, W. C., Ed. *Am. Angler*, N. Y. City.
Hartly, R. M., 627 Walnut St., Philadelphia, Pa.
Hayes, A. A., Washington, D. C.
Henshall, Dr. J. A., 362 Court St., Cincinnati, O.
Hergesheimer, W. S., 1119 N. Eighth St., Philadelphia, Pa.
Hessel, Rudolph, Washington, D. C. (U. S. F. C.)
Hicks, Jno. D., Roslyn, L. I., N. Y.
Hinchman, C. C., Detroit, Mich.
Hofer, J. C., Bellaire, Ohio.
Hudson, Dr. Wm. M., Hartford, Conn. Resigned '93.
Humphreys, Dr. E. W. Saulsbury, Md.
Hutchinson, E. S., Washington, D. C.
Hand, Dr.
Huntington, L. D., New Rochelle, N. Y.
Hale, A. G., Reeds Creek, Delaware Co., N. Y.
Hayes, W. H., Ottawa, Canada.
Hutchinson, Chas., Utica, N. Y.
Hughes, T. W. B., 258 Broadway, New York.
Hoxie, Jno. W., Carolina, R. I.
Hamilton, Robt.
Hackey, D. G.
Hill, W. J., Belmont Ave.
Hazel, Edwin.
Hasbrouck, C. T., Cleveland, Ohio.
Huntington, W. R., Cleveland, Ohio.
Hall, G. W.
Habershaw, Fred.
Holmes, E. S.
Isaacs, Montefiore, 42 Broad St., N. Y.
James, Dr. Bushrod W., N. E. Cor. 18th and Green
Sts., Philadelphia, Pa.
Jessup, F. J., 88 Cortlandt St., New York.
Johnston, S. M., Battery Wharf, Boston, Mass.

Jones, R. W. President Montfrede Fishing Club and Carpenter Brook Fishing Association, Syracuse, N. Y.

Jones, Alexander, Woods Hall, Mass.

Kauffman, S. H., *Evening Star* Office, Washington, D. C.

Kelley, P., 346 Sixth Ave., New York.

Kellogg, A. J., Detroit, Mich. Resigned.

Kingsbury, Dr. C. A., 1119 Walnut St., Philadelphia, Pa. Deceased 1891.

Kimball, W. S., Rochester, N. Y.

Krumbholtz, T. Edmund, Lake Placid, N. Y.

Klock, Geo. S., Rome, N. Y.

Lawrence, G. N., 45 E. 21st St., New York.

Lawrence, F. C., Union Club, New York.

Lee, Thos. (U. S. F. C.) '90.

Little, Amos R., Philadelphia, Pa.

Long, Jas. Vomor, Pittsburg, Pa. '90.

Loring, Jas. A., Room 8, No. 3 Pemberton Sq., Boston, Mass.

Lowry, J. A., Union Club, New York.

Lydecker, Major G. I. (U. S. Engineers.)

Leavenworth, E. W., Wilkesbarre, Pa.

Lynch, Peter W. Resigned '93.

Ledyard, L. W. Resigned '88.

Ladd, W. W., Jr. Resigned '88.

Lyman, Col. T. Resigned '88.

Leeds, Thos. E.

Lampher, Geo. Resigned '88.

Mallory, Chas., Foot Burlington Slip, New York.

Mansfield, Lt. Commander H. B. (U. S. N.), Washington, D. C. '92.

Mather, Fred., Cold Spring Harbor, Suffolk Co., N. Y.

Marks, Walter D., Madison, Wis. '91.

May, W. L., Omaha, Nebraska.

McDonald, Marshall, Washington, D. C. (U. S. F. C.)

McGown, Hon. H. P., 76 Nassau St., New York.

Mackay, Robt. M., 1517 N. 13th St., Philadelphia, Pa.

Middleton, W., Fulton Market, New York.

Milbank, S. W., Union Club, New York.
 Miles, Jacob F., 1820 Arch St., Philadelphia, Pa. '89.
 Miller, Ernest, Fulton Market, New York.
 Miner, C. Harry, New York. '91.
 Moore, Geo. H. H., Washington, D. C. '85.
 Miller, S. B., Fulton Market, New York.
 Miller, Archibald, Norwich, Conn.
 Mills, Geo. T., Carson City, Nevada.
 Miller, Jas. O., Mt. Kisco, N. Y.
 Merrill, Fred. J. H., Ph.D., State Museum, Albany, N. Y.
 Manning, W. W., Marquette, Mich.
 Moon, Geo. T. '85.
 Mann, H. H. '85.
 Mayer, H. M. '86.
 Michan, Wm. S. '95.
 Nevin, James, Madison, Wis. (Wis. Fish Comm.)
 O'Brin, Martin E., South Bend, Nebraska. '88
 O'Connor, J. J., Washington, D. C. (U. S. F. C.)
 Deceased '92.
 Osborn, Hon. C. V., Dayton, Ohio. '90.
 Offensend, Jno. H., Fair Haven, Vt.
 Orvis, Chas. F., Manchester, Vt.
 Page, George, 49 Wall St., New York.
 Page, W. F., Nevsho, Mo. (U. S. F. C.)
 Parker, Dr. J. C., Grand Rapids, Mich.
 Parker, Peter Jr. (U. S. F. C.)
 Pease, Chas., East Rockport, Cuyhoga Co., O. '85.
 Pike Hon. R. G., Middleton, Conn. '86.
 Post, Hoyt, Detroit, Mich. (Mich. Fish Comm.)
 Post, W., Knickerbocker Club, New York.
 Powell, W. L., Harrisburg, Pa. (Penna. F. C.)
 Porter, B. P.
 Page, Geo. Shepherd.
 Preston, Dr. Henry G., 98 Lafayette, Square, Br'klyn.
 Powers, J. A., Troy, N. Y.
 Potter, Judge E. D., Toledo, Ohio. '90.
 Quackenboss, Prof. Jno. D., 331 W. 28th St., New York.
 Rathburn, Richard, Washington, D. C. (U. S. F. C.)

Ray, Hon. Ossian, M.C., New Hampshire. '84.
 Redmond, R., 113 Franklin St., New York.
 Reinecke; Theodore, Box 1651, New York.
 Reynal, J., 84 White St., New York.
 Reynolds, Chas. B., 318 Broadway, New York. '88.
 Ricards, Geo., Hackensack, N. J.
 Robson, Hon. Geo. M., Camden, N. J. '85.
 Ravelan, W. DeC., Washington, D. C. (U. S. F. C.)
 Rufmeyer, L. M. '85.
 Riley, C. V. '85.
 Rice, H. J. '85.
 Rogers, H. M. '88.
 Roosevelt, R. B. '88.
 Rogers, W. H., Amherst, N. H. Deceased Spring of '94.
 Schaffer, Geo. H., Foot of Perry St., New York.
 Scheffelin, W. H. & Co., 170 William St., New York.
 Schuyler, H. P., Troy, New York.
 Schermer, Genl. R. U., New Hartford, Oneida Co., N. Y.
 Simmons, Newton, Washington, D. C. (U. S. F. C.)
 Smiley, C. W., Smithsonian Inst., Washington, D. C.
 Spangler, A. M., 529 Commerce St., Philadelphia, Pa.
 '89.
 Spensley, Calvert, Mineral Point, Wis.
 Spofford, Henry, 10 East 31st St., New York.
 Stone, Livingston, Baird, Shasta Co., California.
 Stone, Summer R., 58 Pine St., New York.
 Swan, B. L., Jr., 5 W. 20th St., New York. Deceased.
 Sweeny, Sr., Dr. R. O., Duluth, Minn.
 Streuber, L., Erie, Pa. (Penna. F. Comm.)
 Strauhan, J. J., Put-in-Bay, Ohio. (U. S. F. C.)
 Seal, W. P. Philadelphia, Pa.
 Stelwagon, Wrightman, Philadelphia, Pa.
 Saranac Lake Hotel Co., Patton & Young, Ampersand,
 Franklyn Co., N. Y. '92.
 Sherwin, H. A., 100 Canal St., Cleveland, Ohio.
 Schullman, C. W. '85.
 Thompson, H. H., Bedford Bank, Brooklyn, N. Y.
 Tomlin, W. D., Duluth, Minn.
 Titcomb, Jno. W., Rutland, Vt. (State F. Comm.)

Taylor, Alexander, Jr., Mamaroneck, N. Y.
Upton, G. W., Warren, Ohio.
Van Valkenburg, B. F., 288 Greenwich St., New York.
Van Cleef, J. S., Poughkeepsie, N. Y.
Van Brunt, C. '86.
Walton, Collins W., 1713 Spring Garden St., Philadelphia, Pa.
Ward, Geo. E., 43 South St., New York. Deceased.
Weeks, Seth, Cory, Erie Co., Pa.
West, Benjamin, Fulton Market, New York.
Whitaker, Herschel, 78 Moffat Building, Detroit, Mich.
Whitney, Sam'l, Katonah, N. Y.
Wilbur, E. H., *Forest and Stream*, New York.
Wilcox, Joseph, Media, Pa. '84.
Wilcox, W. A., 176 Atlantic Ave., Boston, Mass.
Willetts, J. C., Skaneateles, N. Y.
Williams, A. C., Chagrin Falls, Ohio. '88.
Wilmot, Sam'l, Ottawa, Dominion of Canada.
Wilson, J. Paul, Washington, D. C. (U. S. F. C.).
Wood, Benjamin, 25 Park Row, New York.
Woodruff, G. D., Sherman, Conn.
Worth, S. G. Washington, D. C. (U. S. F. C.)
Witherbee, W. C., Port Henry, Essex Co., N. Y.
Welshon, Geo. D., Pittsburg, Pa. '91.
Warren, C. C., Waterbury, Vt. (Fish Comm.)
Wilbur, H. O., Third St., below Race, Philadelphia, Pa.
Webb, W. Seward, 44th St. and Vanderbilt Ave., New York.
Ward, Dr. Samuel, Albany, N. Y. (Prest. New York Fish and Game Association.) Resigned Nov. 5. '93.
Whitaker, E. G., Mutual Life Building, New York.
Wallace, N., Farrington, Conn.
Yealden, J. New York. (Treas. Adirondac Reserve Ass'n.)
Zweighalt, S. 1323 Franklin St., Philadelphia, Pa.

